

Syllabus Details

Name of the department: Department of Agronomy, School of Agricultural Sciences

Academic year: 2020-21

Programme: B.Sc. (Hons.) Agriculture

Programme code - 001

Name	Code	level	Duration (yr/Sem)	Cumulative credit
B.Sc. (Hons.) Agriculture		UG	4 years (8 Sem)	

Semester- I

Course title: Fundamentals of Agronomy

Course Code: 1280010305

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		4 (3+1)	48		10		6	6	64

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
80	5

Component:

Theory

Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil-plant-water relationship, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods, quality of irrigation water, logging. Weeds- importance, classification, crop weed competition, concepts of weed management principles and methods, herbicides- classification, selectivity and resistance, allelopathy. Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.

Practical

Identification of crops, seeds, fertilizers, pesticides and tillage implements, study of agroclimatic zones of India, Identification of weeds in crops, Methods of herbicide and fertilizer application, Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill, Study of soil moisture measuring devices, Measurement of field capacity, bulk density and infiltration rate, Measurement of irrigation water.

A. THEORY

Learning objectives:

1. To understand the basic concepts and components of Agronomy
2. To Understand various agronomic terms
3. To have hands on experience of the basic agronomic practices

Prerequisite: Land, Lab, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Agronomy and its scope, seeds and sowing, tillage and tilling, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency	15	18
Module-II: water resources, soil-plant-water relationship, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods, quality of irrigation water, logging	9	30
Module-III: Weeds- importance, classification, crop weed competition, concepts of weed management principles and methods, herbicides- classification, selectivity and resistance, allelopathy	10	27
Module-IV: Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.	14	25

Course learning outcome: *On successful completion of this course*

CO 1: Understand the basic concepts and components of Agronomy.

CO 2: Evaluate Agriculture from different periods from Veda to modern agriculture.

CO 3: Apply knowledge of basic agronomic principles in successful crop management.

Pedagogy for Course Delivery: *Power point presentation, Verbal presentation by Using white board and marker*

List of Professional Skill Development Activities (PSDA)

1. *Individual analysis*
2. *Group analysis*
3. *Curriculum Development.*
4. *Job analysis*
5. *Task analysis*
6. *Knowledge and skill-gap analysis*

Continuous assessment: *Quiz, assessment, assignment, problem solving etc.*

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. *To understand the basic concepts and components of Agronomy*
2. *To Understand various agronomic terms*
3. *To have hands on experience of the basic agronomic practices*

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Identification of crops, seeds, fertilizers, pesticides.
Practical-2: Identification of different types of tillage implements.
Practical-3: Study of agroclimatic zones of India and West Bengal.
Practical-4: Identification of weeds in crops.
Practical-5: Methods of herbicide application.
Practical-6: Methods of fertilizer application.
Practical-7: Study of yield contributing characters and yield estimation.
Practical-8: To study about seed germination and viability test.
Practical-9: Numerical exercises on fertilizer requirement.
Practical-10: Numerical exercises on plant population.
Practical-11: Numerical exercises on herbicides requirement.
Practical-12: Numerical exercises on water requirement.
Practical-13: To study of soil moisture measuring devices.
Practical-14: Measurement of field capacity, bulk density and infiltration rate.
Practical-15: Measurement of irrigation water.
Practical-16: Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill.

Continuous assessment: Viva-voce, assessment, presentation, problem solving etc.

Text & Reference books:

1. Reddy, S.R. 2016. *Principles of Agronomy*. Kalyani Publishers, Ludhiana, 5th Edition.
2. Yellamanda Reddy, T. and SankaraReddi, G.H. 2016. *Principles of Agronomy*, Kalyani Publishers, Ludhiana.
3. Gopal Chandra De. 1989. *Fundamentals of Agronomy*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Course title: Introduction to Forestry

Course Code: 1280010304

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2 (1+1)	16		16			2	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:**Theory**

Introduction – definitions of basic terms related to forestry, objectives of silviculture, forest classification, salient features of Indian Forest Policies. Forest regeneration, Natural regeneration - natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations. Crown classification. Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning. Forest mensuration – objectives, diameter measurement, instruments used in diameter measurement; Non instrumental methods of height measurement - shadow and single pole method; Instrumental methods of height measurement, geometric and trigonometric principles, instruments used in height measurement; tree stem form, form factor, form quotient, measurement of volume of felled and standing trees, age determination of trees.

Agroforestry – definitions, importance, criteria of selection of trees in agroforestry, different agroforestry systems prevalent in the country, shifting cultivation, taungya, alley cropping, wind breaks and shelter belts, home gardens. Cultivation practices of two important fast growing tree species of the region.

Practical

Identification of tree-species. Diameter measurements using calipers and tape, diameter measurements of forked, buttressed, fluted and leaning trees. Height measurement of standing trees by shadow method, single pole method and hypsometer. Volume measurement of logs using various formulae. Nursery lay out, seed sowing, vegetative propagation techniques. Forest plantations and their management. Visits of nearby forest based industries.

A. THEORY

Learning objectives:

1. The objective of the course is to Identify the tree species and the uses of NTFP.
2. Gain knowledge about the choice of tree species for agro forestry purpose.
3. Estimate the quantity of timber / firewood/NTFP(volume/weight) and other forest resources by using height and volume measuring equipments.
4. Manage the forest nursery by applying nursery techniques.
5. Apply the required cultivation practices for different tree species.

Prerequisite: Land, Lab, instruments, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction – definitions of basic terms related to forestry, objectives of silviculture, forest classification, salient features of Indian Forest Policies.	15	18

Module-II: Forest regeneration, Natural regeneration - natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations. Crown classification. Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning.	9	30
Module-III: Forest mensuration – objectives, diameter measurement, instruments used in diameter measurement; Non instrumental methods of height measurement - shadow and single pole method; Instrumental methods of height measurement, geometric and trigonometric principles, instruments used in height measurement; tree stem form, form factor, form quotient, measurement of volume of felled and standing trees, age determination of trees.	10	27
Module-IV: Agroforestry – definitions, importance, criteria of selection of trees in agroforestry, different agroforestry systems prevalent in the country, shifting cultivation, taungya, alley cropping, wind breaks and shelter belts, home gardens. Cultivation practices of two important fast growing tree species of the region.	14	25

Course learning outcome: *On successful completion of this course students will be able to*

CO1: Identify the abiotic and biotic factors in a forest ecosystem.

CO2: Understand various factors affecting tree growth and forest ecosystem development along with forest ecology.

CO3: Understand the economic value of forest and know many of the products they provide to people and society.

Pedagogy for Course Delivery: *Power point presentation, Verbal presentation by Using white board and marker*

List of Professional Skill Development Activities (PSDA)

1. *Resource management skills are in demand*
2. *Business diversification/income generating activities are needed*

Continuous assessment: *Quiz, assessment, assignment, problem solving etc.*

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. *The objective of the course is to Identify the tree species and the uses of NTFP.*
2. *Gain knowledge about the choice of tree species for agro forestry purpose.*
3. *Estimate the quantity of timber / firewood/NTFP(volume/weight) and other forest resources by using height and volume measuring equipments.*

4. Manage the forest nursery by applying nursery techniques.

5. Apply the required cultivation practices for different tree species.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Identification of seeds and seedlings of multipurpose tree species

Practical-2: Cultivation and nursery practices for poplar.

Practical-3: Cultivation and nursery practices for grewia optiva

Practical-4: Cultivation and nursery practices for morus alba

Practical-5: Cultivation and nursery practices for acacia catechu

Practical-6: Cultivation and nursery practices for delbergia sissoo

Practical-7: Cultivation and nursery practices for robinia

Practical-8: Cultivation and nursery practices for leucaena

Practical-9: Visit to agroforestry fields to study the compatibility of mpts with agriculture crops

Practical-10: Visit to silvi-pasture agroforestry system

Practical-11: Visit to alley cropping and horti-silviculture agroforestry model

Practical-12: Visit to agro-silvipastoral agroforestry model

Practical-13: Visit to fuel-wood and fodder block plantation

Practical-14: Visit to social forestry plantations- railway line plantations

Practical-15: Visit to social forestry plantations- road side plantations

Practical-16: Visit to shelterbelt and industrial plantations

Continuous assessment: Viva-voce, assessment, presentation, problem solving etc.

Text & Reference books:

Bhol N. (2016) Practical Manual of Introduction to Forestry. N B Publication. Bhubaneswar

Bhol N., Mishra V.K. and Chauhan S.K. (2017) Text book of Introduction to Forestry. N.B. Publication, Bhubaneswar

Course title: Fundamentals of Horticulture

Course Code: 1280010301

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2 (1+1)	16		6		10	2	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Horticulture-Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops; Plant propagation-methods and propagating structures; principles of orchard establishment; Principles and methods of training and pruning, juvenility and flower bud differentiation; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; kitchen gardening; garden types and parts; lawn making; medicinal and aromatic plants; species and condiments; use of plant bio-regulators in horticulture. Irrigation & fertilizers application-method and quantity.

Practical

Identification of garden tools. Identification of horticultural crops. Preparation of seed bed/nursery bed. Practice of sexual and asexual methods of propagation. Layout and planting of orchard plants. Training and pruning of fruit trees. Transplanting and care of vegetable seedlings. Making of herbaceous and shrubbery borders. Preparation of potting mixture, potting and repotting. Fertilizer application in different crops. Visits to commercial nurseries/orchard.

A. THEORY

Learning objectives:

1. To introduce the basic concepts of Horticulture and its branches.
2. To create awareness about various types of propagation methods.
3. To know technique of different types of training and pruning system
4. To introduce the different types horticultural crops.

Prerequisite: Classroom, Developed Field

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Horticulture - Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops.	4	25
Module-II: Plant propagation-methods and propagating structures; Seed dormancy, Seed germination.	4	25
Module-III: Principles and methods of training and pruning, juvenility and flower bud differentiation; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; kitchen gardening; garden types and parts; lawn making.	4	25
Module-IV: medicinal and aromatic plants; species and condiments; use of plant bio-regulators in horticulture. Irrigation & fertilizers application-method and quantity.	4	25

Course learning outcome:

- CO1:** Students should be able to apply various horticultural skills and knowledge in their career.
- CO2:** Students should be able to understand sustainable options in horticulture which benefit the environment while maintaining productivity and economic viability.

CO3: Students should be able to understand scope and importance of horticulture, division of horticulture, classification of horticultural plants, brief note on some families of horticultural importance.

CO4: Students should be able to Analyze the Importance of crop physiology in horticulture.

Pedagogy for Course Delivery: verbal presentation with power point.

List of Professional Skill Development Activities (PSDA)

1. Students will understand the basic horticulture biology, taxonomy, and morphology.
2. Students will learn different methods of propagation used in horticulture

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To know the different types of training and pruning methods.
2. To teach basic propagation technique.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Identification of garden tools.

Practical-2: Identification of horticultural crops.

Practical-3: Layout of different planting systems.

Practical-4: Layout of kitchen garden.

Practical-5: Preparation of nursery bed (raised and flat beds) and sowing of seeds.

Practical-6: Practice of different asexual methods by divisions.

Practical-7: Practice of different asexual methods by cuttings.

Practical-8: Practice of different asexual methods by grafting

Practical-9: Practice of different asexual methods by budding.

Practical-10: Practice of different asexual methods by layering.

Practical-11: Training and pruning of fruit trees.

Practical-12: Transplanting and care of vegetable seedlings.

Practical-13: Making of herbaceous and shrubby borders

Practical-14: Preparation of potting mixture, potting and repotting.

Practical-15: Fertilizer application in different crops.

Practical-16: Visits to commercial nurseries/orchard.

Continuous assessment: Viva-voce/assessment etc.

Text & Reference books:

1. Chadha, K.L. 2001. Handbook of Horticulture, ICAR, New Delhi
2. Jitendra Singh, 2012, Basic Horticulture, Kalyani Publishers, New Delhi
3. Randhawa, G.s. and Mukhopadhyaya, A. 1994. Floriculture in India. Allied Publishers Pvt. Ltd. New Delhi.
4. Kumar, N. 1997. Introduction to Horticulture. Rajyalakshmi Publications. Nagorcoil, Tamilnadu.

Course title: Rural Sociology and Educational Psychology

Course Code: 1280010108

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2+0	32		0	0	0		32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
32	2hrs

Component:**Theory**

Sociology and Rural sociology: Definition and scope, its significance in agriculture extension, Social Ecology, Rural society, Social Groups, Social Stratification, Culture concept, Social Institution, Social Change & Development. Educational psychology: Meaning & its importance in agriculture extension. Behaviour: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation, Theories of Motivation, Intelligence.

A. THEORY**Learning objectives:**

1. To understand the basic concept of Rural Sociology, Indian rural society, Importance of rural sociology in Agricultural Extension.
2. To understand social groups, social stratification, culture, social values, social control, social change and their relevance to Agricultural Extension.
3. To understand Educational Psychology, Intelligence, Personality, Perception, Emotion, Frustration, Motivation, Teaching, Learning.

*Prerequisite: Classroom***Course content/Syllabus:**

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Sociology and Rural sociology: Definition and scope, its significance in agriculture extension, Social Ecology, Rural society, Social Groups, Social Stratification	10	31
Module-II: Culture concept, Social Institution, Social Change & Development.	8	25
Module-III: Educational psychology: Meaning & its importance in agriculture extension. Behaviour: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation, Theories of Motivation, Intelligence.	14	44

Course learning outcome:

CO1: Students will understand the characteristics of rural society, social institutions, culture, social values and relevance in Agricultural Extension.

CO2: Students will understand the educational psychology, learning and teaching situation.

CO3: Students will access the personality types, emotions of human beings and motivation.

Pedagogy for Course Delivery: Power point presentation, Verbal presentation by use of white board and marker

List of Professional Skill Development Activities (PSDA): Interaction with the farmers and collect socio-economic information

Continuous assessment: Quiz, assessment, assignment etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

Total no. of practical	Total contact hour	Contact hour/week
0	0	0

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. Adivi Reddy, A. 2006. Extension Education. Sree Lakshmi Press, Bapatla
2. Chitamber, J.B. 1997. Introductory Rural Sociology. Wiley Eastern Limited, New Delhi.
3. Daivadeenam,P. 2006. Educational Psychology in Agriculture. Agrotech Publishing Academy, Udaipur.
4. Mangal, S.K. 2000. Educational Psychology. Prakash Brothers, Ludhiana.
5. Ray, G.L. 2006. Extension Communication and Management. Naya Prokash/Kalyani Publishers, Ludhiana.

Course title: Fundamentals of Plant Biochemistry and Biotechnology

Course Code: 1280011317

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		3 (2+1)	32		16				48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

Importance of Biochemistry. Properties of Water, pH and Buffer. Carbohydrate: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation; Structure of Disaccharides and Poly saccharides. Lipid: Importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids. Proteins: Importance of proteins and classification; Structures, titration and zwitterions nature of amino acids; Structural organization of proteins. Enzymes: General properties; Classification; Mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes. Nucleic acids: Importance and classification; Structure of Nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure. Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain. Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids.

Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation; Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; Marker Assisted Breeding in crop improvement; Biotechnology regulations.

Practical

Preparation of solution, pH & buffers, Qualitative tests of carbohydrates and amino acids. Quantitative estimation of glucose/ proteins. Titration methods for estimation of amino acids/lipids, Effect of pH, temperature and substrate concentration on enzyme action, Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides. Sterilization techniques. Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium. Callus induction from various explants. Micro-propagation, hardening and acclimatization. Demonstration on isolation of DNA. Demonstration of gel electrophoresis techniques and DNA finger printing.

A.THEORY

Learning objectives:

- To provide elementary knowledge/overview of structure, functions and metabolism of biomolecules.*
- To impart knowledge about the catalytic role of enzymes, their structure, physicochemical, kinetic and regulatory properties and mechanism of action.*
- To teach metabolic pathways, their regulation and engineering and methods used in their Elucidation.*

4. To familiarize the students and provide hands on training on various techniques of plant tissue culture, genetic engineering and transformation.

Prerequisite: Classroom, Well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
<p>Module-I: Importance of Biochemistry. Properties of Water, pH and Buffer. Carbohydrate: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation; Structure of Disaccharides and Polysaccharides. Lipid: Importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids. Proteins: Importance of proteins and classification; Structures, titration and zwitterions nature of amino acids; Structural organization of proteins.</p>	9	28
<p>Module-II: Enzymes: General properties; Classification; Mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes. Nucleic acids: Importance and classification; Structure of Nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure. Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain. Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids.</p>	7	22
<p>Module-III: Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation.</p>	9	28
<p>Module-IV: Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; Marker Assisted Breeding in crop improvement; Biotechnology regulations.</p>	7	22

Course learning outcome:

CO1: Understand importance and biochemistry of biological macromolecules like water, carbohydrates and lipids. Detail biochemistry of carbohydrates and lipids.

CO2: Understand amino acids chemistry, peptides and oligopeptides, protein biochemistry and isoelectric point, protein sequencing and different structures of proteins.

CO3: Interpret the nomenclature and classification of enzymes. Develop concept on enzyme kinetics and basic knowledge on nucleic acids.

CO4: Learn the metabolism of carbohydrates, proteins and lipids and secondary metabolites of plants.

CO5: Understand concepts in tissue culture applicable to plants and its application in crop improvement.

CO6: Explain the organization and expression of plant genome, transgenic plants, application of transgenic plants in agriculture and pharmaceutical industry. Learn recombinant DNA technology and its application in biotechnology.

CO7: The student will be able to design, conduct, analyze, and communicate (in writing and orally) biotechnology research.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics. Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

1. Hands-on skills in preparation of buffers and solution
2. Different qualitative test for carbohydrates, lipid and amino acid
3. The skills in biochemical analysis and Enzyme Kinetics
4. Use plant tissue culture in crop
5. Implications biotechnological tools in enhancing crop productivity

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL(total contact hours, hr/week), if applicable

Learning objectives:

1. To impart hands-on skills in preparation of buffers and solution
2. To impart the skills in biochemical analysis
3. To teach basic of plant tissue culture

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Identification of instruments and equipments

Practical-2: Preparation of solutions, pH and buffers

Practical-3: Qualitative tests for carbohydrates.

Practical-4: Estimation of amylose in rice.

Practical-5: Estimation of reducing sugar/ Total soluble sugars.

Practical-6: Qualitative tests amino acids.

Practical-7: Estimation of proteins by Lowrys method.

Practical-8: Extraction of oil from oil seeds by soxhlet apparatus.

Practical-9: Effect of PH, temperature and substrate concentration on enzyme action.

Practical-10: Paper chromatography / TLC demonstration for seperation of amino acids.

Practical-11: Different sterilization techniques

Practical-12: Composition of various tissues culture media and preparation of stock solutions for MS nutrient medium.

Practical-13: Callus induction from various explants.

Practical-14: Micropropagation – Process, Hardening and acclimatization

Practical-15: Demonstration of PCR Technique.

Practical-16: Demonstration of DNA finger printing –RAPD and Restriction digestion.

Continuous assessment: Quiz/assessment/identification/problem solving etc.

Text & Reference books:

S. No	Name	Author(S)	Publisher
1	Principles of Biochemistry	A L Lehninger	WH Freeman publisher & Co
2	Biochemistry- Environment & Agriculture	A P S Maan, S K Munshi and A K Gupta	Kalyani Publishers
3	Fundamentals of Biochemistry	J L Jain	S Chand
4	A Textbook of Biotechnology	R C Dubey	S Chand
5	Biotechnology	U Satyanarayana	Books & Allied Ltd
6	Introduction to plant tissue culture	M K Razdan	Science Pub Inc

Course title: Fundamentals of Soil Science

Course Code: 1280010303

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		3 (2+1)	32		16			3	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

Soil as a natural body, Pedological and edaphological concepts of soil; Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, problem and plant growth, Soil temperature; source, amount and flow of heat in soil; effect on plant growth, Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids - inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms: macro and micro organisms, their beneficial and harmful effects; Soil pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Practical

Study of soil profile in field. Study of soil sampling tools, collection of representative soil sample, its processing and storage. Study of soil forming rocks and minerals. Determination of soil density, moisture content and porosity. Determination of soil texture by feel and

Bouyoucos Methods. Studies of capillary rise phenomenon of water in soil column and water movement in soil. Determination of soil pH and electrical conductivity. Determination of cation exchange capacity of soil. Study of soil map. Determination of soil colour. Demonstration of heat transfer in soil. Estimation of organic matter content of soil.

A. THEORY

Learning objectives:

1. To impart knowledge to the students on the basics and fundamentals of Soil Science
2. To impart skills in collecting and analyzing soils for basic physical, physico-chemical and chemical properties for using it as a medium for plant growth.

Prerequisite: Well-equipped laboratory, white board and marker, classroom with projector.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Soil as a natural body, Pedological and edaphological concepts of soil; Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil;	4	12.50
Module-II: Elementary knowledge of soil taxonomy classification and soils of India	3	9.375
Module-III: Soil physical properties: soil-texture, structure, density and porosity; soil colour, consistence and plasticity; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, problem and plant growth; Soil temperature; source, amount and flow of heat in soil; effect on plant growth	10	31.25
Module-IV: Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability	3	9.375
Module-V: Soil colloids - inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation exchange capacity, base saturation; Soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms: macro and micro organisms, their beneficial and harmful effects	9	28.125
Module-VI: Soil pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution	3	9.375

Course learning outcome:

CO 1: Understand the fundamentals, principles, formation of soil and the soils of India and the soil classification patterns

CO2: Interpret various soil physical properties and their impact on plant growth.

CO3: Explain how soil reaction influence nutrient availability and plant growth.

CO4: Interpret inorganic and organic soil colloids, their chemistry and behavior.

CO5: Evaluate the soils for basic physical, physico-chemical & chemical properties to ascertain problems of cultivation, soil pollution and its effect on crop and mitigation of soil pollution.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA)

1. Pedological and edaphological concepts of soil
2. Analysis of different soil physical and chemical properties.
3. Management and solution of soil pollution.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. Understand the fundamentals of soil formation and profile development
2. Interpret various soil physical properties and their impact on plant growth.
3. Interpret various soil chemical properties and their impact on plant growth.
4. Explain how soil colour, heat transfer and reactions influence plant growth
5. Design and develop skill of accurate soil sampling and soil map generation

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Study of soil profile in field.

Practical-2: Study of soil sampling tools,

Practical-3: Collection of representative soil sample, its processing and storage.

Practical-4: Study of soil forming rocks and minerals.

Practical-5: Determination of soil density,

Practical-6: Determination of soil moisture content

Practical-7: Determination of soil porosity.

Practical-8: Determination of soil texture by feel and Bouyoucos Methods.

Practical-9: Studies of capillary rise phenomenon of water in soil column and water movement in soil.

Practical-10: Determination of soil pH.

Practical-11: Determination of soil electrical conductivity.

Practical-12: Determination of cation exchange capacity of soil.

Practical-13: Study of soil map.

Practical-14: Determination of heat transfer in soil.

Practical-15: Determination of heat transfer in soil.

Practical-16: Estimation of organic matter content of soil.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. Biswas, T. D., & Mukherjee, S. K. (2001). *Textbook of soil sciences*. Tata McGraw-Hill Education.
2. Indian Society of Soil Science. (2012). *Fundamentals of Soil Science*, IARI, New Delhi.
3. Das, D.K. (2015). *Introductory Soil Science, 4th Edition*, Kalyani Publishers, New Delhi
4. Sehgal, J. (2015). *A Text Book of Pedology – Concepts and Applications*, Kalyani publishers, New Delhi.

Course title: Introductory Biology

Course Code: 2280010302

Type	Code	Credit	Credit division					Total no of lecture
			L	T	P	SW	FW	
Remedial courses		2 (1+1)	16		16			32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Introduction to the living world, diversity and characteristics of life, origin of life, Evolution and Eugenics. Binomial nomenclature and classification Cell and cell division. Morphology of flowering plants. Seed and seed germination. Plant systematic- viz; Brassicaceae, Fabaceae and Poaceae. Role of animals in agriculture.

Practical

Morphology of flowering plants – root, stem and leaf and their modifications. Inflorescence, flower and fruits. Cell, tissues & cell division. Internal structure of root, stem and leaf. Study of specimens and slides. Description of plants - Brassicaceae, Fabaceae and Poaceae.

A.THEORY

Learning objectives:

1. To understand life, origin, evolution
2. To gain the knowledge about morphology of flowering plants
3. To learn about different plant family

Prerequisite: Classroom, Well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction to the living world, diversity and characteristics of life, origin of life, Evolution and Eugenics.	2	14
Module-II: Binomial nomenclature and classification Cell and cell division.	3	18
Module-III: Morphology of flowering plants. Seed and seed germination.	7	43
Module-IV: Plant systematic- viz; Brassicaceae, Fabaceae and Poaceae. Role of animals in agriculture	4	25

Course learning outcome:

CO1: The student will be able to read, understand, and critically interpret the primary biological literature in his/her area of interest.

CO2: The student will be able to explain the importance of biodiversity at the genetic, organism, community, and global scales.

CO3: The student will be able to explain the process of organic evolution and its underlying principles and mechanisms.

CO4: The student will be able to explain the fundamental biological processes of metabolism, homeostasis, reproduction, development, and genetics, and the relationships between form and function of biological structures at the molecular, cellular, organism, population, and ecosystem levels of the biological hierarchy.

CO5: The student will be able to read, understand and explain morphology of flowering plants.

CO6: The student will recognize and be able to interpret different agricultural and horticultural plant.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics. Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL(total contact hours, hr/week), if applicable

Learning objectives:

1. To learn the handling of microscope to observed phases of cell division
2. To demonstrate different morphological part of plant

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Study of cell and organelle

- Practical-2: Study of different tissues
 Practical-3: Different stages of cell division
 Practical-4: Morphology of flowering plants-root and their modification
 Practical-5: Morphology of flowering plants-stem and their modification
 Practical-6: Morphology of flowering plants-leaf and their modification
 Practical-7: Study of different type of inflorescence
 Practical-8: Study of different type of flower
 Practical-9: Study of different type of fruit
 Practical-10: Study of the internal structure of root
 Practical-11: Study of the internal structure of stem
 Practical-12: Study of the internal structure of leaf
 Practical-13: Study of specimens and slides
 Practical-14: Description of family brassicaceae plants
 Practical-15: Description of family fabaceae plants
 Practical-16: Description of family poaceae plants

Continuous assessment: Quiz/assessment/identification/problem solving etc.

Text & Reference books:

S. No	Name	Author(S)	Publisher
1	Introduction to Biology	D. G. Mackean	John Murray
2	Introduction to Biology	Jane Horlings	Kendall/Hunt Publishing Company
3	Introduction to Biology and Biotechnology	K. Vaidyanath, K. Pratap Reddy, K. Satya Prasad	CRC Press

Course title: Agricultural Heritage

Course Code: 1280010107

Type	Code	Credit	Credit division					Total no of lecture
			L	T	P	SW	FW	
Remedial		1+0	16		0			16

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
16	1hr

Component:

Theory

Introduction of Indian agricultural heritage; Ancient agricultural practices, Relevance of heritage to present day agriculture; Past and present status of agriculture and farmers in society; Journey of Indian agriculture and its development from past to modern era; Plant production and protection through indigenous traditional knowledge; Crop voyage in India and world; Agriculture scope; Importance of agriculture and agricultural resources available in India; Crop significance and classifications; National agriculture setup in India; Current scenario of Indian agriculture; Indian agricultural concerns and future prospects.

Learning objectives:

Agricultural Heritage is to promote student understanding, awareness about sustainable agriculture and to safeguard the social, cultural, economic and environmental goods and services these provide to family farmers, smallholders, indigenous peoples and local communities.

Prerequisite: Classroom

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction of Indian agricultural heritage; Ancient agricultural practices, Relevance of heritage to present day agriculture; Past and present status of agriculture and farmers in society	8	50
Module-II: Journey of Indian agriculture and its development from past to modern era; Plant production and protection through indigenous traditional knowledge; Crop voyage in India and world; Agriculture scope.	4	25
Module-III: Importance of agriculture and agricultural resources available in India; Crop significance and classifications; National agriculture setup in India; Current scenario of Indian agriculture; Indian agricultural concerns and future prospects.	4	25

Course learning outcome:

On the completion of the course, students will be able to learn about:

CO1: Ancient Agricultural Practices & its relevant to modern agriculture practices.

CO2: Student will understand the journey of Indian agriculture from past to modern era.

CO3: Students will learn about importance of agriculture and agricultural resources available in India.

Pedagogy for Course Delivery: Power point presentation, Verbal presentation by use of white board and Marker

List of Professional Skill Development Activities (PSDA):

Continuous assessment: Quiz, assessment, assignment etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

Total no. of practical	Total contact hour	Contact hour/week
0	0	0

Text & Reference books:

- 1.Zaman and Sagar Maitra, Agricultural Heritage, Palmview publishers
2. ICAR 1989 Handbook of Agriculture, Indian Council of Agricultural Research, New-Delhi.
3. Nene, Y.L. 2007. Glimpses of the Agricultural Heritage of India. Asian Agri History Foundation, Secunderabad, Andhra Pradesh.
4. Nene, Y.L., Saxena, R.C. and Choudhary, S.L. 2009. A Textbook on Ancient History of Indian Agriculture, Munshiram Manoharial Publishers Pvt. Ltd,

5. Nene, Y.L., Choudhary, S.L. and Saxena, R.C. 2010. Textbook on Ancient History of Indian Agriculture, Asian Agri-History Foundation.
6. D. Kumari, Manimuthu Veeral. 2014. Text Book on Agricultural Heritage of India. Agrotech Publishing Academy.
7. ICAR. Introductory Agriculture. ICAR e-course. Indian Council of Agricultural Research, New Delhi.

Course title: Human Values and Ethics

Course Code: 1140014148

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Non Gradual		1+0	16		0				16

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
16	1hrs

Component:

Theory

Universal human aspirations: Happiness and prosperity; Human values and ethics: Concept, definition, significance and sources; Fundamental values: Right conduct, peace, truth, love and non-violence; Ethics: professional, environmental, ICT; Sensitization towards others particularly senior citizens, developmentally challenged and gender. Spirituality, positive attitude and scientific temper; Team work and volunteering; Rights and responsibilities; Road safety; Human relations and family harmony; Modern challenges and value conflict: Sensitization against drug abuse and other social evils; Developing personal code of conduct (SWOT Analysis); Management of anger and stress.

Learning objectives:

- To create an awareness about the goal, mission, and vision of life
- To develop the ethic and human values inside the students.

Prerequisite: Classroom

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Universal human aspirations: Happiness and prosperity; Human values and ethics: Concept, definition, significance and sources.	2	13
Module-II: Fundamental values: Right conduct, peace, truth, love and non-violence; Ethics: professional, environmental, ICT; Sensitization towards others particularly senior citizens, developmentally challenged and gender.	6	37
Module-III: Spirituality, positive attitude and scientific temper; Team work and	4	25

volunteering; Rights and responsibilities; Road safety; Human relations and family harmony.		
Module-IV: Modern challenges and value conflict: Sensitization against drug abuse and other social evils; Developing personal code of conduct (SWOT Analysis); Management of anger and stress.	4	25

Course learning outcome:

CO1: Student will understand about the goal, mission, and vision of life

CO2: Students will understand the concept of decision making, motivation, sensitivity, success, selfless service.

CO3: Student will learn about principles and philosophy, self-exploration, self-awareness, self-satisfaction.

Pedagogy for Course Delivery: Power point presentation, Verbal presentation by Use of white board and Markers

List of Professional Skill Development Activities (PSDA):

Continuous assessment: Quiz, assessment, assignment etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

Total no. of practical	Total contact hour	Contact hour/week
0	0	0

Text & Reference books:

1. A Textbook on Professional Ethics and Human Values-R.S. Naagarazan-New Age International.
2. Gaur RR, Sangal R & Bagaria GP. 2011. A Foundation Course in Human Values and Professional
3. Ethics. Excel Books.
4. Mathur SS. 2010. Education for Values, Environment and Human Rights. RSA International.
5. Sharma RA. 2011. Human Values and Education -Axiology, Inculcation and Research. R. Lall
6. Book Depot.
7. Sharma RP & Sharma M. 2011. Value Education and Professional Ethics. Kanishka Publishers.
8. Srivastava S. 2011. Human Values and Professional Ethics. S K Kataria & Sons.
9. Srivastava S. 2011. Environmental Science. S K Kataria & Sons.
10. Tripathi A.N. 2009. Human Values. New Age International (P) Ltd Publishers.

Semester II

Course title: Fundamentals of Genetics

Course Code: 1280010302

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		3(2+1)	32		16			4	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory:

Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity. Architecture of chromosome; chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; special types of chromosomes. Chromosomal theory of inheritance- cell cycle and cell division- mitosis and meiosis. Probability and Chi-square. Dominance relationships, Epistatic interactions with example. Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanisms, chromosome mapping. Structural and numerical variations in chromosome and their implications, Use of haploids, dihaploids and doubled haploids in Genetics. Mutation, classification, methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation. Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance. Genetic disorders. Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.

Practical:

Study of microscope. Study of cell structure. Mitosis and Meiosis cell division. Experiments on monohybrid, dihybrid, trihybrid, test cross and back cross, Experiments on epistatic interactions including test cross and back cross, Practice on mitotic and meiotic cell division, Experiments on probability and Chi-square test. Determination of linkage and cross-over analysis (through two point test cross and three point test cross data). Study on sex linked inheritance in *Drosophila*. Study of models on DNA and RNA structures.

A. THEORY

Learning objectives:

- 1. Genetics is a fundamental science which deals with the study of genes, characters, and their inheritance. The knowledge of genetics has become essential to unravel the mysteries of life processes that are extensively pursued in today's science.*
- 2. This course is designed to understand the major concepts and processes of genetics. It provides a foundation for understanding the rule of inheritance and genetics applications for undergraduate students.*
- 3. This concept will help them to understand the basics of plant breeding in future.*

Prerequisite: Well-equipped laboratory, white board and marker, classroom with projector.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I : Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity. Architecture of chromosome; chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; special types of chromosomes. Chromosomal theory of inheritance- cell cycle and cell division- mitosis and meiosis.	8	25
Module-II: Probability and Chi-square. Dominance relationships, Epistatic interactions with example. Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics,	7	22
Module-III: Linkage and its estimation, crossing over mechanisms, chromosome mapping. Structural and numerical variations in chromosome and their implications, Use of haploids, dihaploids and doubled haploids in Genetics. Mutation, classification, Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation. Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance. Genetic disorders	9	28
Module-IV: Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.	8	25

Course learning outcome:

CO1: Learn a historical overview of genetics and understand how a fully formed concept of genetics was put-forth. Learn the laws of Inheritance in pea plants and other systems. Understand the applications of Mendel's principles and chromosome ultrastructure and function.

CO2: Understand chromosomal theory of inheritance, cell cycle and concept of cell division. Learn the various gene interactions and their outcome.

CO3: Understand the molecular basis of sex determination and dosage compensation in Drosophila and Man. Know the role of the environment in sex determination and hormonal control of sex determination. Learn linkage and crossing over and their role in breeding experiments and chromosome aberrations.

CO4: Understand the concept of mutations and mutagenic agents.

CO5: Be able to differentiate between quantitative and mendelian traits. Understand the basic principles of quantitative trait inheritance and the concept of cytoplasmic inheritance,

CO6: Learn about genes at molecular level. Learn about DNA, RNA and their replication, mutations, DNA repair mechanism. Understand the basics of gene expression in prokaryotic systems.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

1. Idea about gene and gene expression
2. Preparation of linkage map
3. Idea about QTL and QTL mapping
4. Idea about heritability and gene action

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. Understand the basic concepts of the ultrastructure of cell, cell organelles, chromosomes and nucleic acids.
2. Apply the principles of inheritance to plant breeding

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Study of microscope

Practical-2: Study of cell structure

Practical-3: Preparation of slide for demonstration of mitosis using onion roots.

Practical-4: Preparation of slide for demonstration of meiosis using onion flowers.

Practical-5: Experiments on monohybrid, dihybrid, trihybrid cross

Practical-6: Experiments on test cross and back cross

Practical-7: Problems related to gene interaction Part-1

Practical-8: Problems related to gene interaction Part-2

Practical-9: Problems related to gene interaction Part-3

Practical-10: Experiments on probability

Practical-11: Experiments on Chi-square test

Practical-12: Determination of linkage and cross-over analysis (Two point test cross)

Practical-13: Determination of linkage and cross-over analysis (Three point test cross)

Practical-14: Study on sex linked inheritance in Drosophila part1

Practical-15: Study on sex linked inheritance in Drosophila part2

Practical-16: Study of models of DNA and RNA structure.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Genetics by BD Singh; Kalyani Publishers (1 January, 2009)
2. Gardner E. J. M. J. Simmons and D.P. Snustad, 2006, *Principles of Genetics*. 8th edition. John Wiley & Sons. INC. New York
3. Tamarin, R H., 2009, *Principles of Genetics*. McGraw-Hill
4. Strickberger M. W., 2012. *Genetics*. Mac Millan Publishing Co. NewYork.
5. Watson, J. D., T. A. Baker S. P. Bell, A Cann, M. Levine and R. Losick, 2014. *Molecular Biology of Gene* 7th Edition, Pearson Education RH Ltd. India.

Course title: Agricultural Microbiology

Course Code: 1280011309

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2 (1+1)	16		16			1	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:**Theory**

Introduction. Microbial world: Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination transformation, conjugation and transduction, plasmids, transposon. Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles. Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere. Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste.

Practical

Introduction to microbiology laboratory and its equipments; Microscope- parts, principles of microscopy, resolving power and numerical aperture. Methods of sterilization. Nutritional media and their preparations. Enumeration of microbial population in soil- bacteria, fungi, actinomycetes. Methods of isolation and purification of microbial cultures. Isolation of Rhizobium from legume root nodule. Isolation of Azotobacter from soil. Isolation of Azospirillum from roots. Isolation of BGA. Staining and microscopic examination of microbes.

A.THEORY*Learning objectives:*

1. To teach the students about basics in development of microbiology, difference in prokaryotes and eukaryotic cell.
2. To gain knowledge about bacterial genetics
3. Students will able to apply subject knowledge prokaryotic and eukaryotic microbes, about the biofuel production and biodegradation of agro-waste
4. Students will learn about silage production, biofertilizers, bio pesticides

Prerequisite: Classroom, Well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction. Microbial world: Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth.	4	25
Module-II: Bacterial genetics: Genetic recombination transformation, conjugation and transduction, plasmids, transposon.	4	25

Module-III: Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles. Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere.	6	38
Module-IV: Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste.	2	12

Course learning outcome:

CO1: Student will understand the basic microbial structure, function and study the comparative characteristics of prokaryotes and eukaryotes.

CO2: To know the various Physical and Chemical growth requirements of bacteria

CO3: Impart knowledge about production of beneficial bacteria, silage, biofertilizers, biopesticides, biofuel and biodegradation of agro-waste.

CO4: Impart knowledge about production of role of microbes in soil fertility and crop production

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics. Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

1. Demonstrate farmer use of biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL(total contact hours, hr/week), if applicable

Learning objectives:

1. To learn the handling of microscope.
2. Isolation of microbial population and multiplication

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Introduction to microbiology laboratory and its equipments

Practical-2: Microscope-Parts, principles of microscopy, resolving power and numerical aperture
Practical-3: Methods of sterilization

Practical-4: Nutritional media and their preparation-I

Practical-5: Nutritional media and their preparation-II

Practical-6: Enumeration of bacteria population in soil

Practical-7: Isolation of fungi and multiplication

Practical-8: Isolation of actinomycetes and multiplication

Practical-9: Methods of isolation and purification of microbial cultures-I

Practical-10: Methods of isolation and purification of microbial cultures-II

Practical-11: Isolation of *Rhizobium* from legume root nodule

Practical-12: Isolation of *Azotobacter* from soil

Practical-13: Isolation of *Azospirillum* from root

Practical-14: Isolation of BGA

Practical-15: Staining and microscopic examination of microbes-I

Practical-16: Staining and microscopic examination of microbes-II

Continuous assessment: Quiz/assessment/identification/problem solving etc.

Text & Reference books:

S.No.	Name	Author(S)	Publisher
1	Microbiology	R P Singh	Kalyani Publishers
2	General Microbiology	R P Singh	Kalyani Publishers
3	Mushroom cultivation	PAU	PAU
4	Agricultural Microbiology	N Mukhrjee & T Ghose	Kalyani Publishers

Course title: Soil and Water Conservation Engineering

Course Code: 1280011310

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2(1+1)	16		16			3	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory:

Introduction to Soil and Water Conservation, causes of soil erosion. Definition and agents of soil erosion, water erosion: Forms of water erosion. Gully classification and control measures. Soil loss estimation by universal Loss Soil Equation. Soil loss measurement techniques. Principles of erosion control: Introduction to contouring, strip cropping. Contour bund. Graded bund and bench terracing. Grassed water ways and their design. Water harvesting and its techniques. Wind erosion: mechanics of wind erosion, types of soil movement. Principles of wind erosion control and its control measures.

Practical:

General status of soil conservation in India. Calculation of erosion index. Estimation of soil loss. Measurement of soil loss. Preparation of contour maps. Design of grassed water ways. Design of contour bunds. Design of graded bunds. Design of bench terracing system. Problem on wind erosion.

A. THEORY

Learning objectives:

1. This course deals with the engineering principles involved in soil and water conservation.
2. It includes the classification of the water erosion, and the agronomical and engineering measures adopted for erosion control.

3. *The design of bunds and terraces are dealt in detail, followed by gully control measures.*
4. *The wind erosion and measures to control it, e.g., the windbreaks and shelterbelt, are also included.*

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction to Soil and Water Conservation, causes of soil erosion. Definition and agents of soil erosion, water erosion: Forms of water erosion.	2	12.5
Module-II: Gully classification and control measures. Soil loss estimation by universal Loss Soil Equation. Soil loss measurement techniques.	4	25.0
Module-III: Principles of erosion control: Introduction to contouring, strip cropping. Contour bund. Graded bund and bench terracing. Grassed water ways and their design	6	37.5
Module-IV: Water harvesting and its techniques.	2	12.5
Module-V: Wind erosion: mechanics of wind erosion, types of soil movement. Principles of wind erosion control and its control measures.	2	12.5

Course learning outcome:

CO1: Understand the soil erosion caused by erosive agents like water and wind along with its conservation measures.

CO2: Design and analysis of the agronomic and engineering methods of conservation like bunds and terraces.

CO3: Understand the principles of erosion control measures.

CO4: Design and application of water harvesting techniques.

CO5: Analysis the mechanism of wind erosion and its control measures.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

1. *Learn and apply the measurement techniques of soil erosion caused by water and wind.*
2. *Design and development of water harvesting techniques*
3. *Engineering aspect of different erosion control measures.*

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. Understand the basic concepts of different soil and wind erosion and its measures
2. Design and estimation of soil loss and different erosion control structures

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

- Practical-1 Study of erosion status of India
- Practical-2 Study of different types and forms of water erosion.
- Practical-3 Exercises on computation of rainfall erosivity index.
- Practical-4 Computation of soil erodibility index in soil loss estimation.
- Practical-5 Determination of length of slope (LS) and cropping practice (CP) factors for soil loss estimation by USLE and MUSLE.
- Practical-6 Exercises on soil loss estimation/measuring techniques.
- Practical-7 Study of rainfall simulator for erosion assessment.
- Practical-8 Design and layout of contour bunds.
- Practical-9 Design and layout of graded bunds.
- Practical-10 Design and layout of broad base terraces.
- Practical-11 Design and layout of bench terraces.
- Practical-12 Design of vegetative waterways.
- Practical-13 Exercises on rate of sedimentation and storage loss in tanks.
- Practical-14 Computation of soil loss by wind erosion.
- Practical-15 Design of shelter belts and wind breaks for wind erosion control.
- Practical-16 Visit to soil erosion sites and watershed project areas for studying erosion control and water conservation measures.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi. Indian Society of Soil Science. (2012). Fundamentals of Soil Science, IARI, New Delhi.
2. Hydrology and Soil Conservation Engineering: Including Watershed Management by Ghanshyam das.
3. Mal, B.C. 2014. Introduction to Soil and Water Conservation Engineering. 2014. Kalyani Publishers.

Course title: Fundamentals of Crop Physiology

Course Code: 1280011311

Type	Code	Credit	Credit division					Total no of lecture
			L	T	P	SW	FW	
Compulsory		2 (1+1)	16		16			32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Introduction to crop physiology and its importance in Agriculture; Plant cell: an Overview; Diffusion and osmosis; Absorption of water, transpiration and Stomatal Physiology; Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms; Photosynthesis: Light and Dark reactions, C3, C4 and CAM plants; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism: Fatty acid synthesis and Breakdown; Plant growth regulators: Physiological roles and agricultural uses, Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity.

Practical

Study of plant cells, structure and distribution of stomata, imbibitions, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, Separation of photosynthetic pigments through paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue test for mineral nutrients, estimation of relative water content, Measurement of photosynthetic CO₂ assimilation by Infra Red Gas Analyser (IRGA).

A.THEORY

Learning objectives:

1. To understand plant cell structure, organization, and apply specific biochemical functions to all compartments of the plant cell, the process of imbibitions, osmosis, plasmolysis.
2. To gain the knowledge about Photosynthesis- Light and Dark reactions, C3, C4 and CAM plants; Respiration- Glycolysis and TCA cycle
3. To learn about the plant growth regulators

Prerequisite: Classroom, Well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction to crop physiology and its importance in Agriculture; Plant cell: an Overview	3	18
Module-II: Diffusion and osmosis; Absorption of water, transpiration and Stomatal Physiology; Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms	3	18
Module-III: Photosynthesis: Light and Dark reactions, C3, C4 and CAM plants; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism: Fatty acid synthesis and Breakdown	8	50
Module-IV: Plant growth regulators: Physiological roles and agricultural uses, Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity.	2	14

Course learning outcome:

CO1: Role of crop physiology in crop health.

CO2: Identification of deficiency symptoms of nutrients.

CO3: To understand the various physiological mechanisms of plant and develop concepts about the plant growth regulators.

CO4: To know the difference between C3, C4 and CAM plant.

CO5: Importance of physiological aspects of different crop plants.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics. Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

1. Demonstrate a coherent and systematic approach to the experimental and theoretical aspects of crop physiology

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL(total contact hours, hr/week), if applicable

Learning objectives:

1. To learn the handling of microscope.
2. To demonstrate different physiological process

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Study of plant cell structure

Practical-2: Study of stomatal distribution

Practical-3: Study of osmosis by potato osmometer

Practical-4: Study of imbibition in Raisins

Practical-5: Study of plasmolysis in Plant Cell

Practical-6: Measurement of root pressure

Practical-7: Rate of transpiration

Practical-8: Separation of photosynthetic pigments through paper chromatography-I

Practical-9: Separation of photosynthetic pigments through paper chromatography-II

Practical-10: Rate of photosynthesis

Practical-11: Rate of respiration

Practical-12: Tissue test for mineral nutrients-I

Practical-13: Tissue test for mineral nutrients-II

Practical-14: Tissue test for mineral nutrients-III

Practical-15: Estimation of relative water content (RWC)

Practical-16: Measurement of photosynthetic CO₂ assimilation by Infra Red Gas Analyzer

Continuous assessment: Quiz/assessment/identification/problem solving etc.

Text & Reference books:

S. No	Name	Author(S)	Publisher
1	Plant Physiology	Lincoln Taiz, Eduardo Zeiger	Sinauer Associates Inc

2	Plant Physiology	H N Srivastava	Pradeep Publishers
3	Plant Physiology	N K Gupta & Sunita Gupta	Oxford and IBH publications, New Delhi

Course title: Fundamentals of Agricultural Economics

Course Code: 1280011112

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2 (2+0)	32	0	0	0	0	5	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
32	2 hrs

Component:**Theory**

Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macro-economics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behaviour. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country. Demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Production: process, creation of utility, factors of production, input output relationship. Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply. Concepts of rent, wage, interest and profit. National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation, public revenue and public expenditure. Tax: meaning, direct and indirect taxes, agricultural taxation, VAT. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

A. THEORY*Learning objectives:*

1. To introduce the basic concepts of agricultural economics, micro and macro-economics and its application.
2. To provide an overview of elements of business success in agriculture.
3. To learn consumer behavior consisting of consumer's utility maximization problem and demand theory.
4. To familiarize the students about the crop and economics.
5. To provide the orientation to the students regarding the concepts and measures of economic development.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macro-economics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of	6	19

equilibrium, economic laws as generalization of human behaviour.		
Module-II: Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country. Demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, Equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity.	11	34
Module-III: Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control	4	13
Module-IV: Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation, public revenue and public expenditure. Tax: meaning, direct and indirect taxes, agricultural taxation, VAT.	8	25
Module-V: Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.	3	9

Course learning outcome:

CO1: To analyse elements of business success in agriculture and its application.

CO2: To remember the elements that determine economic role of agriculture in national economy.

CO3: To recognize biological and economic laws in agricultural production and in decision-making process on agricultural and rural development at micro and macroeconomic level.

CO4: To Understand the agricultural policies and its effect on sustainable agricultural development.

CO5: To evaluate knowledge on fundamental concepts and models in the theory of production and costs and sets out to provide a basic understanding of price and or output determination under different types of market structures including factor markets.

Pedagogy for Course Delivery: PowerPoint presentation and verbal presentation by using White board and marker.

List of Professional Skill Development Activities (PSDA)

1. *Understand the agricultural policies and its effect on sustainable agricultural development.*
2. *Expose the students to the theory of general equilibrium and welfare economics*
3. *Gaining Knowledge on fundamental concepts and models in the theory of production and costs and sets out to provide a basic understanding of price and or output determination under different types of market structures including factor markets.*
4. *Identify elements that determine economic role of agriculture in national economy.*
5. *Over view of macroeconomic concepts with theory and understand the application of the macroeconomic theory to analyze the implication of the macroeconomic policies.*

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

Text & Reference books:

1. *Dewett, K.K. and Varma, J.D. 2003. Elementary Economic Theory. S.Chand and Co, New Delhi.*
2. *Dewett, K.K. and Chand, A. 2009. Modern Economic Theory. S.Chand and Co, New Delhi.*
3. *Koutsoyiannis. 2015. Modern Microeconomics. Tata-Mac Graw Hill Publishers, New Delhi.*
4. *Paul A. Samuelson and Nordhus. 2010. Economics. 19th Edition, Tata-Mac Graw Hill Education, New Delhi.*
5. *S. Subba Reddy, P. Raghuram, T. V. Neelakanta Sastry and I. Bhavani Devi. Agricultural Economics.*

Course title: Fundamentals of Plant Pathology

Course Code: 1280011313

Type	Code	Credit	Credit division					Total no of lecture
			L	T	P	SW	FW	
Compulsory		4 (3+1)	3		1			64

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
80	5

Component:

Theory

Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Causes and factors affecting disease development: Disease triangle and tetrahedron and classification of plant diseases. Important plant pathogenic organisms (different groups): fungi, bacteria, phytoplasma, spiroplasma, viruses, viroids, algae, protozoa and phanerogamic plant parasites with example of diseases caused by them. Diseases and symptoms due to abiotic causes. Pathogenesis, Role of enzymes, toxins and growth regulators in disease development. Defence mechanism in plants. Epidemiology: Factors affecting disease development. Fungi: General characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions, sub-divisions, orders and classes. Bacteria and mollicutes: General morphological characters. Basic methods of classification and reproduction. Viruses: Nature, architecture, multiplication and transmission. Growth and reproduction of plant pathogens. Liberation, dispersal and survival of plant pathogens. Types of parasitism and variability in plant pathogens.

Practical

Acquaintance with various laboratory equipments and microscopy. Preparation of media, isolation and Koch's postulates. General study of different structures of fungi. Study of symptoms of various plant diseases. Study of representative fungal genera. Staining and identification of plant pathogenic bacteria. Transmission of plant viruses. Study of phanerogamic plant parasites. Study of fungicides and their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations.

A. THEORY

Learning objectives:

1. To introduce the basic concepts of plant pathology, scope and objectives of Plant Pathology.
2. To create awareness about various microbes that causes diseases of plants and the nature of different types of microorganisms.
3. To develop the knowledge about the characteristics and process of multiplication of Fungi, Bacteria and Virus
4. To develop the knowledge about the defence mechanism of plant so that by using those defence mechanism we can manage the plant diseases.

Prerequisite: Classroom & well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Causes / factors	14	30

affecting disease development: disease triangle and tetrahedron and classification of plant diseases. Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes.		
Module-II: Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions, subdivisions, orders and classes.	8	17
Module-III: Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction. Viruses: nature, structure, replication and transmission. Study of phanerogamic plant parasites. Nematodes: General morphology and reproduction, classification, symptoms and nature of damage caused by plant nematodes (<i>Heterodera</i> , <i>Meloidogyne</i> , <i>Anguina</i> , <i>Radopholus</i> etc.)	11	21
Module-IV: Growth and reproduction of plant pathogens. Liberation / dispersal and survival of plant pathogens. Types of parasitism and variability in plant pathogens. Pathogenesis. Role of enzymes, toxins and growth regulators in disease development. Defence mechanism in plants. Epidemiology: Factors affecting disease development. Principles and methods of plant disease management. Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.	15	32

Course learning outcome:

CO1: Understanding the concept of disease, causal agents of plant diseases.

CO2: To impart knowledge about the classification and identification of micro organisms (fungi, bacteria, virus etc.) based on their morphology

CO3: Remembering the methods and management of crop diseases.

CO4: Students will analyze the defence mechanism of plant may be it is structural or biochemical and their use in plant disease management.

Prerequisite: Software, computer, classroom.

Pedagogy for Course Delivery:

List of Professional Skill Development Activities (PSDA)

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL(total contact hours, hr/week), if applicable

Learning objectives:

Main objective of the practical is to gather knowledge about the different morphological characteristics of fungus, bacteria and how to preserve them for future

purpose. The students will also be able to know how to evaluate the fungicide spray concentrations for applying them on crops and the safe use of pesticide while handling them.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

- Practical-1: Acquaintance with various laboratory equipments and microscopy.
 Practical-2: Collection and preservation of disease specimen.
 Practical-3: Preparation of media, isolation and Koch's postulates.
 Practical-4: General study of different structures of fungi, Part-I.
 Practical-5: General study of different structures of fungi, Part-II.
 Practical-6: Study of symptoms of various plant diseases.
 Practical-7: Study of representative fungal genera.
 Practical-8: Staining and identification of plant pathogenic bacteria.
 Practical-9: Transmission of plant viruses.
 Practical-10: Study of phanerogamic plant parasites.
 Practical-11: Study of fungicides and their formulations.
 Practical-12: Methods of pesticide application and their safe use.
 Practical-13: Calculation of fungicide sprays concentrations.
 Practical-14: Study of morphological features and identification of plant parasitic nematodes
 Practical-15: Sampling and extraction of nematodes from soil and plant material, preparation of nematode mounting, Part-I.
 Practical-16: Sampling and extraction of nematodes from soil and plant material, preparation of nematode mounting, Part-II.

Continuous assessment: Quiz/assessment/identification/problem solving etc.

Text & Reference books:

A Textbook of Fungi, Bacteria and Viruses by H.C.Dube

Introduction to Principles of Plant Pathology by R.S.Singh

Additional reading: Plant Pathology, 5th edition by George N. Agrios

Course title: Fundamentals of Entomology

Course Code: 1280011314

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		4 (3+1)	3		1			2	64

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
80	5

Component:

Theory

UNIT I- History of Entomology in India. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor.

UNIT II- Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors– temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors – food competition, natural and environmental resistance.

UNIT III- Categories of pests. Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Chemical control importance, hazards and limitations. Recent methods of pest control, repellents, antifeedants, hormones, attractants, gamma radiation. Insecticides Act 1968- Important provisions. Application techniques of spray fluids. Symptoms of poisoning, first aid and antidotes.

UNIT IV- Systematics: Taxonomy importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Tysanoptera: Tripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Tysanoptera: Tripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae. Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

Practical

Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper); Dissection of male and female reproductive systems in insects (Grasshopper); Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance. Insecticides and their formulations. Pesticide appliances and their maintenance. Sampling techniques for estimation of insect population and damage.

A. THEORY

Learning objectives:

1. *To understand about the morphology and physiology of insects.*

2. To impart knowledge about the classification and identification of insects based on their morphology.
3. To gather knowledge about the influence of ecological factors on insect development and distribution, understand components of integrated pest management.
4. To know the classification of insecticides, and their use in pest management.

Prerequisite: Software, computer, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: History of Entomology in India. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor.	10	21
Module-II: Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors– temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors – food competition, natural and environmental resistance.	6	13
Module-III: Categories of pests. Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Chemical control importance, hazards and limitations. Recent methods of pest control, repellents, antifeedants, hormones, attractants, gamma radiation. Insecticides Act 1968- Important provisions. Application techniques of spray fluids. Symptoms of poisoning, first aid and antidotes.	16	33
Module-IV: Systematics: Taxonomy importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae,	16	33

Blattidae; Odonata; Isoptera: Termitidae; Tysanoptera: Tripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae. Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.		
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• **Course learning outcome:**

CO1: To know the major points related to dominance of Insecta in Animal kingdom

CO2: To attain a solid information in insect anatomy, morphology, physiology and taxonomy

CO3: To develop an understanding of the distributions and abundances of organisms including insects, and their interactions with each other and the environment

CO4: To acquire the knowledge on classification of insecticides, their manufacture, trade names by which the students can take it in an entrepreneurship mode.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board.

PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

1. Techniques of insect collection for identification.
2. Insecticide recommendation for management practices.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To demonstrate the basic handling regarding the collection and preservation of insects.
2. To acquire knowledge on pesticide handling.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Methods of collection and preservation of insects including immature stages

Practical-2: External features of Grasshopper/Blister beetle

Practical-3: Types of insect antennae, mouthparts and legs

Practical-4: Wing venation, types of wings and wing coupling apparatus

Practical-5: Types of insect larvae and pupae

Practical-6: Dissection of digestive system in insects (Grasshopper)

Practical-7: Dissection of male and female reproductive systems in insects (Grasshopper)

Practical-8: Study of characters of orders Orthoptera, Dictyoptera and their families of agricultural importance

Practical-9: Study of characters of orders Odonata, Isoptera and their families of agricultural importance

Practical-10: Study of characters of orders Thysanoptera, Hemiptera and their families of agricultural importance

Practical-11: Study of characters of orders Lepidoptera, Neuroptera and their families of agricultural importance

Practical-12: Study of characters of orders Coleoptera and families of agricultural importance

Practical-13: Study of characters of orders Hymenoptera and families of agricultural importance

Practical-14: Study of characters of orders Diptera and families of agricultural importance

Practical-15: Insecticides and their formulations. Pesticide appliances and their maintenance

Practical-16: Sampling techniques for estimation of insect population and damage.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. Chapman, R F. 1988. *Insects:Structure and Function*, Cambridge Univ. Press, UK.
2. Nayar,K K, Ananthkrishnan, T N and David, B V. 1976. *General and Applied Entomology*, Tata McGraw-Hill Publishing Co Ltd.,New Delhi
3. Pant, N C and Ghai, S. 1981. *Insect Physiology and Anatomy*. ICAR, New Delhi
4. Richards, O W and Davies, R G. 1977. *Imm's General text Book of Entomology (Vol.I and II)*, Chapman and Hall, London.
5. Vasantha Raj David, B. 2003. *Elements of Economic Entomology*. Popular Book Depot. Coimbatore.
6. Dhawaliwal GS and Ramesh Arora. 2001. *Integrated Pest Management-Concepts and Approaches*, Kalyanai Publishers, Ludhiana.

Course title: Fundamentals of Agricultural Extension Education

Course Code: 1280011315

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2+1	32		16			3	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4hrs

Component:

Theory

Education: Meaning, definition & Types; Extension Education- meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme Planning-Meaning, Process, Principles and Steps in Programme Development. Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc. Rural Development: concept, meaning, definition; various rural development programmes launched by Govt. of India. Community Dev.-meaning, definition, concept & principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and social media), media mix strategies; communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

Practical

To get acquainted with university extension system. Group discussion- exercise; handling and use of audio visual equipment and digital camera and LCD projector; preparation and use of AV aids, preparation of extension literature – leaflet, booklet, folder, pamphlet news stories and success stories; Presentation skills exercise; micro teaching exercise; A visit to village to understand the problems being encountered by the villagers/ farmers; to study organization and functioning of DRDA and other development departments at district level; visit to NGO and learning from their experience in rural development; understanding PRA techniques and their application in village development planning; exposure to mass media: visit to community radio and television studio for understanding the process of programme production; script writing, writing for print and electronic media, developing script for radio and television.

Learning objectives:

1. To orient the students with the concept of extension education and its importance in agricultural development.
2. To expose the students towards various rural development programmes aimed at poverty alleviation and to increase employment opportunities and their analysis.
3. To orient the students learning about the extension system worldwide and new dimensions of Agricultural Extension in India.

Prerequisite: Classroom, Laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Education: Meaning, definition & Types; Extension Education- meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme Planning-Meaning, Process, Principles and Steps in Programme Development.	8	13
Module-II: Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.).	12	19
Module-III: New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc. Rural Development: concept, meaning, definition; various rural development programmes launched by Govt. of India.	12	19
Module-IV: Community Dev.-meaning, definition, concept & principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; extension administration: meaning and concept, principles and functions.	7	10
Module-V: Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and social media), media mix strategies; communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.	25	39

Course learning outcome:

CO1: Students will get knowledge and concept of extension and its importance in agricultural development.

CO2: Students are exposed towards various rural development programmes aimed at poverty alleviation and to increase employment opportunities and their analysis.

CO3: Students will have knowledge about various types of communication skills.

Pedagogy for Course Delivery: Power point presentation, Verbal presentation by Use of white board and Marker

List of Professional Skill Development Activities (PSDA): Group discussion, Debate, Seminar

Continuous assessment: Quiz, assessment, assignment etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

- To understand the university extension system
- To develop good communication skill.
- To develop good leadership quality.
- To understand the status of the rural community.
- To understand how to collect information from rural household.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2hrs

List of Practical

Practical 1: University Extension system

Practical 2: Usage of Newspaper as audio-visual aid in extension

Practical 3: Preparation of Leaflet

Practical 4: DRDA (District Rural Development Agency)

Practical 5: Preparation of poster

Practical 6: Structure of a questionnaire

Practical 7: Debate

Practical 8: Preparation of model

Practical 9: Microteaching

Practical 10: Television script writing

Practical 11: Community radio station

Practical 12: Radio script writing

Practical 13: Newspaper article writing

Practical 14: PRA- Venn diagram

Practical 15: Role and function of KVK

Practical 16: PRA- Time trend analysis

Continuous assessment: Assessment, Outreach activities, Power point presentation, problem solving skills, Communication skills etc.

Text & Reference books:

1. Dimensions of Agriculture Extension - TNAU
2. Agricultural Extension and Rural Development Handout- Hudu Zakaria
3. Extension Communication and Management- G. L. Ray

Course title: Communication Skills and Personality Development

Course Code: 1280011316

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		1+1	16		16			4	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3hrs

Component:**Theory**

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

Learning objectives:

- To Develop Communication Skills as well as Positive Personality Traits
- To Acquire a Language Suitable for Technical Communication
- To Inculcate the Habit of Regular Reading and Writing.

Prerequisite: Classroom, Laboratory**Course content/Syllabus:**

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication.	4	25
Module-II: Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures.	4	25
Module-III: Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.	8	50

Course learning outcome:

After getting information from the course

CO1: Students will be able to write simple and correct sentences.

CO2: Students will be able to write Papers, Proposals, Reports etc.

CO3: Students will be able to appreciate any piece of writing and comprehend it.

Pedagogy for Course Delivery: Power point presentation, Verbal presentation by Using of white board

List of Professional Skill Development Activities (PSDA): Group discussion, Debate, Seminar, outreach activities

Continuous assessment: Quiz, assessment, assignment etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

- *To develop good communication skill.*
- *To develop scientific writing ability.*
- *To understand the chain of command.*

Total no. of practical	Total contact hour	Contact hour/week
16	32	2hrs

List of Practical

Practical 1: Group Discussion

Practical 2: Debate

Practical 3: Note taking skills

Practical 4: Article writing

Practical 5: Precis writing

Practical 6: Abstract writing

Practical 7: Individual power point presentation

Practical 8: Group power point presentation

Practical 9: Impromptu presentation

Practical 10: Study of bibliographic procedure

Practical 11: Public speaking

Practical 12: Study to use of field diary and lab record

Practical 13: Analysis of listening skill

Practical 14: Conduction of an interview

Practical 15: Study to develop business skills

Practical 16: PRA- Study to conduct business communication practice- Notice, Writing of meeting minutes, resolution

Continuous assessment: Viva-Voce, Assessment etc.

Text & Reference books:

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011.

2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011
3. Organizational Behaviour, Stephen.P. Robbins, 1stEdition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green Hall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals – PHI, 2011.

Semester III

Course title: Crop Production Technology-I (Kharif Crops)

Course Code: 1280012318

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2 (1+1)	16		16			5	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Kharif crops. Cereals – rice, maize, sorghum, pearl millet and finger millet, pulses-pigeonpea, mungbean and urdbean; oilseeds- groundnut, and soybean; fibre crops- cotton & jute; forage crops-sorghum, cowpea, cluster bean and napier.

Practical

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeonpea and mungbean. maize, groundnut and cotton, effect of seed size on germination and seedling vigour of kharif season crops, effect of sowing depth on germination of kharif crops, identification of weeds in kharif season crops, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of kharif season crops, study of crop varieties and important agronomic experiments at experimental farm. study of forage experiments, morphological description of kharif season crops, visit to research centres of related crops.

A. THEORY

Learning objectives:

To teach the crop husbandry of cereals, forage, fibers, oil seed and pulse crops.

Prerequisite: Land, lab, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Kharif crops. Cereals – rice, maize, sorghum, pearl millet and finger millet.	3	18
Module-II: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Kharif crops. Pulses-pigeonpea, mungbean and urdbean;	7	45
Module-III: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Kharif crops. Oilseeds- groundnut, and soybean;	2	12
Module-IV: Origin, geographical distribution,	4	25

economic importance, soil and climatic requirements, varieties, cultural practices and yield of Kharif crops. Fibre crops- cotton & jute; forage crops-sorghum, cowpea, cluster bean and napier.		
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Course learning outcome: On successful completion of this course students will be able to

CO1: Learn the origin, geographical distribution and economic importance of kharif crops.

CO2: Learn the soil and climatic requirements, varieties of kharif crop.

CO3: Learn the cultural practices of kharif crop.

Pedagogy for Course Delivery: Power point presentation, Verbal presentation by Using white board and marker

List of Professional Skill Development Activities (PSDA)

1. Demonstrate an ability to work effectively with others.
2. Recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable decisions.
3. A fundamental understanding of economic principles and their application to agricultural, resource, rural and related issues.
4. Knowledge dissemination regarding various technique of farming and farming system, types of market and marketing of agricultural produce.
5. Acquire the ability to engage in independent and life-long learning in the ever-changing agricultural production system/enterprises.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

To teach the crop husbandry of cereals, forage, fibers, oil seed and pulse crops.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

- Practical-1: Rice nursery preparation.
- Practical-2: Transplanting of rice.
- Practical-3: Sowing of soybean.
- Practical-4: Sowing of pigeon pea.
- Practical-5: Sowing of mungbean.
- Practical-6: Sowing of soybean.
- Practical-7: Sowing of maize.
- Practical-8: Sowing of groundnut.
- Practical-9: Sowing of cotton.
- Practical-10: Effect of seed size on germination and seedling vigour of kharif season crops
- Practical-11: Effect of sowing depth on germination of kharif crops.
- Practical-12: Identification of weeds in kharif season crops.
- Practical-13: To study about top dressing and foliar feeding of nutrients.

Practical-14: study of yield contributing characters and yield calculation of kharif season crops.

Practical-15: To study of crop varieties and important agronomic experiments at experimental farm.

Practical-16: To study of forage experiments, morphological description of kharif season crops, visit to research centres of related crops.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Reddy, S.R. and Reddi Ramu. 5th edition. *Agronomy of Field Crops*, Kalyani Publishers, Ludhiana.
2. Chidda Singh, Singh, P. and Singh, R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Rajendra Prasad (ed.), 2004. *Text Book of Field Crop Production, Commercial Crops, Volume -II*. ICAR, New Delhi.
4. Singh, S.S. 1998, *Crop Management: Under irrigated and rainfed conditions*.
5. Singh, S.S. 1993, *Principles and Practices of Agronomy*, Kalyani Publishers, New Delhi.
6. Reddy, T.Y. and Reddi, G.H.S. 1993. *Principles of Agronomy*, Kalyani Publishers, New Delhi.
7. Maiti, S. , Hedge, M.R. and Chhattopadhyay, S.B. 1988. *Handbook of Annual Oil Seed Crops*. Oxford & IBH Publishing Co., New Delhi.
8. Jaiswami, L.H. and Baldeo, B. 1990. *Advances in Pulse Production Technology*, ICAR, New Delhi.
9. Thakur, C. 1979. *Crop Production, Vol. I & II*. Metropolitan Book Pvt. Ltd., New Delhi.
10. Ahlawat, I.P.S. , Sharma, O.P. & Saini., G.S. 1998 *Scientific Crop Production in India*. Aman Publishing House, Madhu Market, Budhana gate, Meerut.
11. Rathore, P.S. 1999-2000. *Techniques and Management of Field Crop Production*. Agrobios (India), Jodhpur.
12. Rathore, P.S. and Sharma, S.K. 2003. *Scientific Pulse Production*. Yash Publishing House, Bikaner.
13. Sharma, Kalicharan 1990 *Bharat ki promokh faslea*. G.B. Pant Agricultural & Technology University, Nanital.
14. Reddy, S.R. 2004. *Agronomy of Field Crops*. Kalyani Publishers, New Delhi.

Course title: Fundamentals of Plant Breeding

Course Code: 1280012319

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		3(2+1)	32		16			4	48

Total contact hour	Contact hour/week
64	4

Component:

Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male sterility- genetic consequences, cultivar options. Domestication, Acclimatization and Introduction; Centres of origin/ diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement Schemes- Ear to row method, Modified Ear to Row, recurrent selection schemes; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Maintenance of breeding records and data collection; Wide hybridization and prebreeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and & Farmer's Rights.

Practical

Plant Breeder's kit, Study of germplasm of various crops. Study of floral structure of self-pollinated and cross pollinated crops. Emasculation and hybridization techniques in self & cross pollinated crops. Consequences of inbreeding on genetic structure of resulting populations. Study of male sterility system. Handling of segregation populations. Methods of calculating mean, range, variance, standard deviation, heritability. Designs used in plant breeding experiments, analysis of Randomized Block Design. To work out the mode of pollination in a given crop and extent of natural out-crossing. Prediction of performance of double cross hybrids.

A. THEORY

Learning objectives:

- 1. The basic objective of this course to impart knowledge to the students on the principles and procedures of plant breeding in self and cross pollinated crops for development of the high yielding varieties / hybrids with the help of various conventional and modern molecular approaches.*
- 2. To create awareness about centre of origin, crossing techniques, male sterility and self incompatible lines, wide hybridization, polyploidy.*
- 3. To spread an understanding about biotechnological tools and molecular markers and marker assisted selection.*
- 4. To create knowledge about statistical techniques and designs used in breeding plots.*

Prerequisite: Well-equipped laboratory, white board and marker, classroom with projector.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Historical development, concept, nature and role of plant breeding, major achievements and future prospects. Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male sterility- genetic	6	20

consequences, cultivar options. Domestication, acclimatization and introduction; Centres of origin/ diversity, components of genetic variation.		
Module-II: Heritability and genetic advance. Genetic basis and breeding methods in self-pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population. Multiline concept. Concepts of population genetics and Hardy- Weinberg Law, genetic basis and methods of breeding cross pollinated crops, modes of selection.	8	25
Module-III: Population improvement Schemes. Ear to row method, modified ear to row, recurrent selection schemes. Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties. Breeding methods in asexually propagated crops, clonal selection and hybridization.	6	19
Module-IV: Maintenance of breeding records and data collection. Wide hybridization and pre breeding. Polyploidy in relation to plant breeding, mutation breeding-methods and uses. Breeding for important biotic and abiotic stresses.	5	15
Module-V: Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and & Farmer's Rights.	7	21

Course learning outcome:

CO1: Learn about historical aspect of plant breeding, achievements and challenges, concept and utilization of male sterility and self-incompatibility in plant breeding. Students will learn the centers of diversity and components of variability

CO2: 2.Learn breeding procedures in self and cross pollinated crops, understand exploitation of heterosis utilizing male sterility and other methods. Students will be well versed in population genetics concept.

CO3: Understand different population improvement schemes and breeding approach of vegetatively propagated crops

CO4: Know the requirements in breeding for biotic and abiotic stress tolerant varieties, study about the fundamentals of mutation, polyploidy and wide hybridization and their role in crop improvement

CO5: Orientation regarding modern molecular approaches like Marker Assisted Selection. Learn the impact of IPRs including PBR, PVP and PPVFRA

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

- 1. Idea about emasculation and crossing techniques, hybrid seed development.*
- 2. Maintenance of segregating generation*

3. *Idea about gene and allelic frequency*
4. *Use of PCR, gel electrophoresis and different molecular markers.*

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. *Understand the basic concepts of the ultrastructure of cell, cell organelles, chromosomes and nucleic acids.*
2. *Apply the principles of inheritance to plant breeding*

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Study about Plant Breeder's kit

Practical-2: Study of germplasm of various crops

Practical-3: Study of the floral structure of self-pollinated crops: Rice, wheat.

Practical-4: Study of the floral structure of self-pollinated crops: Chickpea, tomato

Practical-5: Study of the floral structure of self-pollinated crops: mustard.

Practical-6: Study of the floral structure of Cross-pollinated crops: Maize

Practical-7: Study of the floral structure of Cross-pollinated crops: Sunflower

Practical-8: Emasculation and hybridization techniques: Rice

Practical-9: Emasculation and hybridization techniques: Wheat

Practical-10: Consequences of inbreeding on genetic structure of resulting populations

Practical-11: Study of male sterility system.

Practical-12: Methods of calculating mean, range, variance, standard deviation

Practical-13: Designs used in plant breeding experiment.

Practical-14: Analysis of Randomized Block Design.

Practical-15: To work out the mode of pollination in a given crop and extent of natural outcrossing

Practical-16: Prediction of performance of double-cross hybrid

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Plant Breeding Principles and Methods by B.D. Singh, Kalyani Publishers.
2. Essentials of Plant Breeding by Phundan Singh, Kalyani Publishers.
3. Principles of Plant Breeding By Robert W Allard, Wiley; 2nd edition

Course title: Agricultural Marketing, Trade and Prices

Course Code: 1280012320

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		3 (2+1)	32		16	0	1	5	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4 R's, and 3C's of credits. Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks, Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, World Bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis. Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.

Practical

Determination of most profitable level of capital use. Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank and cooperative society to acquire first-hand knowledge of their management, schemes and procedures. Estimation of credit requirement of farm business – A case study. Preparation and analysis of balance sheet – A case study. Preparation and analysis of income statement – A case study. Appraisal of a loan proposal – A case study. Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value added products. Seminar on selected topics.

A. THEORY

Learning objectives:

1. *To learn about different credit needs and its role in Indian agriculture, credit analysis, sources of agricultural finance.*
2. *To enhance knowledge on various appraisal techniques of agricultural investment projects.*
3. *To familiarize about the different cooperatives working in India.*

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4 R's, and 3C's of credits.	8	25
Module-II: Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks, Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost.	8	25
Module-III: An introduction to higher	8	25

financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.		
Module-IV: Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers’ service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.	8	25

Course learning outcome:

CO1: To understand how the commercial banks are working, functioning the RRB’s, KCC and lead bank scheme, preparing the income statements, balance sheets and project proposal.

CO2: To analyse the different credit needs and its role in Indian agriculture, credit analysis, sources of agricultural finance.

CO3: To remember biological and economic laws in agricultural production and in decision-making process on agricultural and rural development at micro and macroeconomic level.

CO4: To evaluate the basic knowledge on various appraisal techniques in investment of agricultural projects.

Pedagogy for Course Delivery: PowerPoint presentation and verbal presentation by using White board and marker.

List of Professional Skill Development Activities (PSDA)

1. Gain knowledge relating to disbursement of institutional finance to priority sector, credit management and financial risk management.
2. Acquire the basic knowledge on various appraisal techniques in investment of agricultural projects.
3. Expose the students to research methodology used in social sciences.
4. Learn the economics and impacts of agricultural projects and various methods to capture cost and value of project.
5. Learn methods used to assess the feasibility of the projects.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To familiarize the students about the financial conditions and different types of cooperation

2. To gain knowledge to characterize the scope and complexity of modern projects.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Determining optimum level of capital (with diagram)

Practical-2: Economic feasibility tests of credit.

Practical-3: Optimum allocation of limited amount of capital among different enterprises:

Case Study: SWOT Analysis

Practical-4: Working out the various loan repayment plans

Practical-5: Study of Primary Agricultural Co-operative Credit Society (PACCS) District Central Co-operative Bank.

Practical-6: Visit to an Agricultural Finance Institution (Bank Visit and Crop Loan Application)

Practical-7: Study of Regional Rural Bank

Practical-8: Study of National Bank for Agriculture and Rural Development (NABARD)

Practical-9: Study of Self Help Group (SHG)

Practical-10: Estimation of Scale of Finance/Credit requirement for cultivation of different crops.

Practical-11: Agricultural projects – evaluation

Practical-12: Techno-economic parameters /economic feasibility of long-term investment

Practical-13: Study of break-even analysis of project involving in large investment

Practical-14: Formulation of loan proposal for agricultural crops

Practical-15: Preparation and Analysis of Balance Sheet and Income Statement

Practical-16: Seminar on selected topics.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. Lekhi, R.K. and Singh, J. *Agricultural Economics*, Kalyani publishers, Ludhiana.
2. S. Subba Reddy, P. Raghu Ram, T. V. Neelakanta Sastry and I. Bhavani Devi. *Agricultural Economics*.

Course title: Agri-Informatics

Course Code: 1280012322

Type	Code	Credit	Credit division					No. of PSDA	Total no of lecture
			L	T	P	SW	FW		
Compulsory		2(1+1)	16		16			4	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory:

Introduction to Computers, Operating Systems, definition and types, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components. Introduction to computer programming languages, concepts and standard input/output operations.

e-Agriculture, concepts and applications, Use of ICT in Agriculture. Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc for supporting Farm decisions. Preparation of contingent crop-planning using IT tools.

Practical:

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix/ Linux, Creating, Files & Folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific Document. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data. MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system. Introduction to World Wide Web (WWW). Introduction of programming languages. Hands on Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/ Wofost; Computation of water and nutrient requirements of crop using CSM and IT tools. Introduction of Geospatial Technology for generating valuable information for Agriculture. Hands on Decision Support System. Preparation of contingent crop planning.

A. THEORY

Learning objectives:

1. To get basic idea about computer and MS Office
2. To know about e-Agriculture, use of ICT and IT application in Agriculture
3. To learn about geospatial technology, smart agriculture to support the farmers.

Prerequisite: Well-equipped laboratory, white board and marker, classroom with projector.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction to Computers, Operating Systems, definition and types, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions,	3	18.75
Module-II: Database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components. Introduction to computer programming languages, concepts and standard input/output operations.	3	18.75
Module-III: e-Agriculture, concepts and applications, Use of ICT in Agriculture. Computer Models for understanding plant processes.	3	18.75
Module-IV: IT application for computation of	3	18.75

water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc;		
Module-V: Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc for supporting Farm decisions. Preparation of contingent crop-planning using IT tools.	4	25

Course learning outcome:

CO1: Understanding of Computer and application of MS Office.

CO2: Application of computer programming, e-agriculture, WWW, ICT and Computer Models for understanding plant processes

CO3: Application of IT, Geospatial technology, Smartphone Apps in Agriculture for farm advises

CO4: Application of DSS in agriculture for better crop management.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

1. *Computer programming language*
2. *DSS and ICT application in agriculture*
3. *Computer Models for understanding plant processes*
4. *Geospatial technology for generating valuable agri-information*

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. *To understand the basic concepts of COMPUTER, MS Office*
2. *To learn the crop simulation models and DSS for crop management*
3. *To get knowledge and application about Geospatial technology.*

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

- Practical-1 *Study of Computer Components, accessories, practice of important DOS Commands.*
- Practical-2 *Introduction of different operating systems such as windows, Unix/Linux,*
- Practical-3 *Creating, Files & Folders, File Management.*
- Practical-4 *Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific Document.*
- Practical-5 *MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data.*

- Practical-6 *MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system.*
- Practical-7 *Introduction to World Wide Web (WWW)*
- Practical-8 *Introduction of programming languages.*
- Practical-9 *Hands on Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/ Wofost;*
- Practical-10 *Computation of water and nutrient requirements of crop using CSM and IT tools.*
- Practical-11 *Introduction of Geospatial Technology for generating valuable information for Agriculture. Hands on Decision Support System. Preparation of contingent crop planning.*
- Practical-12 *Hands on Decision Support System.*
- Practical-13 *Preparation of contingent crop planning*
- Continuous assessment:** Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Introductory Agri Informatics According To New Icar Syallabus (Pb) by Mahapatra, Subrat K Et Al, Jain Brothers
2. A Text Book of Agri-Informatics by Amit Deogirikar and Sanchali Kshirsagar by M/s Shri Rajlakshi Prakashan, Aurngabad

Course title: Farm Machinery and Power

Course Code: 1280012321

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		1(1+1)	16		16			3	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory:

Status of Farm Power in India, Sources of Farm Power , I.C. engines, working principles of I C engines, comparison of two stroke and four stroke cycle engines , Study of different components of I.C. engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication ,fuel supply and hydraulic control system of a tractor, Familiarization with Power transmission system : clutch, gear box, differential and final drive of a tractor , Tractor types, Cost analysis of tractor power and attached implement, Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture, implement for intercultural operations, Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

Practical:

Study of different components of I.C. engine. To study air cleaning and cooling system of engine, Familiarization with clutch, transmission, differential and final drive of a tractor, Familiarization with lubrication and fuel supply system of engine, Familiarization with brake, steering, hydraulic control system of engine, Learning of tractor driving, Familiarization with operation of power tiller, Implements for hill agriculture, Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow . Familiarization with seedcum- fertilizer drills their seed metering mechanism and calibration, planters and transplanter Familiarization with different types of sprayers and dusters Familiarization with different intercultivation equipment, Familiarization with harvesting and threshing machinery.

A. THEORY

Learning objectives:

1. *To know about the basics of different farm power units and implements.*
 2. *To engage students in studying the design and performance of different farm power units and implements; factors determining their selection; their efficient use; and maintenance.*
 3. *To familiarize with Primary and Secondary Tillage implement.*
 4. *To familiarize with Plant Protection equipment, harvesting and threshing equipment.*
- Prerequisite: Well-equipped laboratory, white board and marker, classroom with projector.*

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Status of Farm Power in India, Sources of Farm Power	1	6.25
Module-II: I.C. engines, working principles of I C engines, comparison of two stroke and four stroke cycle engines , Study of different components of I.C. engine, I.C. engine terminology and solved problems,	3	18.75
Module-III: Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication ,fuel supply and hydraulic control system of a tractor, Familiarization with Power transmission system : clutch, gear box, differential and final drive of a tractor , Tractor types, Cost analysis of tractor power and attached implement,	4	25.00
Module-IV: Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture, implement for intercultural operations,	2	12.50
Module-V: Familiarization with seedcum-fertilizer drills their seed metering mechanism and calibration, planters and transplanter Familiarization with different types of sprayers and dusters.	4	25.00
Module-VI: Familiarization with different intercultivation equipment, Familiarization with harvesting and threshing machinery.	2	12.50

Course learning outcome:

CO1: Understand the working principle of Internal Combustion engines.

CO2: Application of different components of Internal Combustion engines

CO3: Understand and application of different Primary and Secondary Tillage implement,

CO4: Application of implements related to intercultural operation, seed cum fertilizer drill, sprayer and dusters and harvesting machinery.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

1. Knowledge of tractor and different farm power related to agriculture
2. Farm mechanization
3. Equip the technical knowledge and skills required for the operation of tillage, plant protection, harvesting and threshing machinery needed for agricultural farms.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To understand the working principle of different systems and parts of internal combustion engines.
2. To equip with technical knowledge and skills required for the operation of Tillage.
3. Sowing and intercultural and plant protection machinery needed for agricultural farms.
4. To acquire skills required for the operation, maintenance and evaluation of harvesting, threshing machinery needed for agricultural farms.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

- Practical-1 Study of different components of I.C. engine.
- Practical-2 To study air cleaning and cooling system of engine,
- Practical-3 Familiarization with clutch and transmission of a tractor,
- Practical-4 Familiarization with differential and final drive of a tractor,
- Practical-5 Familiarization with lubrication system of engine,
- Practical-6 Familiarization with fuel supply system of engine,
- Practical-7 Familiarization with brake, steering, hydraulic control system of engine,
- Practical-8 Learning of tractor driving,
- Practical-9 Familiarization with operation of power tiller,
- Practical-10 Implements for hill agriculture,
- Practical-11 Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow .
- Practical-12 Familiarization with seedcum- fertilizer drills
- Practical-13 Seed metering mechanism and calibration of seedcum- fertilizer drills and planters and transplanter
- Practical-14 Familiarization with different types of sprayers and dusters.
- Practical-15 Familiarization with different intercultivation equipment,
- Practical-16 Familiarization with harvesting and threshing machinery

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Elements of Agricultural Engineering by Jagdiswar Sahay.
2. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi
3. Jain, S.C. and C.R.Rai. Farm Tractor and maintenance and repair.

Course title: Production Technology for Vegetables and Spices

Course Code: 1280012326

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2 (1+1)	16		6		10	2	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Importance of vegetables & spices in human nutrition and national economy, kitchen gardening, brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders, of important vegetable and spices (Tomato, Brinjal, Chilli, Capsicum, Cucumber, Melons, Gourds, Pumpkin, French bean, Peas; Cole crops such as Cabbage, Cauliflower, Knol-khol; Bulb crops such as Onion, Garlic; Root crops such as Carrot, Raddish, Beetroot; Tuber crops such as Potato; Leafy vegetables such as Amaranth, Palak. Perennial vegetables).

Practical

Identification of vegetables & spice crops and their seeds. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables & spices. Fertilizers applications. Harvesting & preparation for market. Economics of vegetables and spices cultivation.

A. THEORY

Learning objectives:

1. To know about the production technology for vegetables.
2. To know about the production technology for species.
3. Students will assess and modify cultural practices used in the production of vegetable crops, including the integration of soil science, plant physiology, plant nutrition, agro meteorology and crop protection

Prerequisite: Classroom, Developed Field.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Importance of vegetables & spices in human nutrition and national economy, kitchen gardening, brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders, of important vegetable and spices..	4	25

Module-II: Production technology of Tomato, Brinjal, Chilli, Capsicum, Cucumber, Melons, Gourds, Pumpkin, French bean, Peas; Cole crops such as Cabbage, Cauliflower, Knolkhol.	4	25
Module-III: Production technology of Bulb crops such as Onion, Garlic; Root crops such as Carrot, Radish, Beetroot.	4	25
Module-IV: Production technology of Tuber crops such as Potato; Leafy vegetables such as Amaranth, Palak. Perennial vegetables.	4	25

Course learning outcome:

CO1: students will be able to understand production technology of vegetables crops.

CO2: students will be able to apply the knowledge about botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management.

CO3: students will be able to analyse the principles and methods of quality seed and planting material production in vegetable crops.

CO4: students will be able to apply Types of vegetable gardening with special reference to kitchen gardening.

Pedagogy for Course Delivery: verbal presentation with power point.

List of Professional Skill Development Activities (PSDA)

1. To know the production technology of different types of vegetable crops.
2. Understand and analyze the factors that affect the distribution of the industry at the global to regional levels, from small community and roof-top gardens to large acreage, commercial production for local consumption, processing and export.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To know the production technology of different types of vegetable crops.
2. To know the nursery raising of vegetable crops.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Identification of vegetables and their seeds.

Practical-2: Identification of spices crops and their seeds.

Practical-3: Nursery raising techniques of vegetable crops.

Practical-4: Direct seed sowing and transplanting

Practical-5: Preparation of nursery bed (raised and flat beds) and sowing of seeds.

Practical-6: Study of morphological characters of different vegetables.

Practical-7: Study of morphological characters of different spices.

Practical-8: Physiological disorders of vegetable crops.

Practical-9: Intercultural operations in vegetable crops.

Practical-10: Seed extraction methods in vegetables and spices

Practical-11: Harvest indices and maturity standards of vegetable crops.

- Practical-12: Transplanting and care of vegetable seedlings.
 Practical-13: Fertilizers applications different vegetable crops.
 Practical-14: Economics of vegetables and spices cultivation.
 Practical-15: Visit to vegetable farmer fields.
 Practical-16: Visit to vegetable markets to study marketing problems.

Continuous assessment: Viva-voce/assessment etc.

Text & Reference books:

1. Pranab Hazra, A.Chattopadhyay, K.Karmakar and S.Dutta.2010. Modern Technology in Vegetable Production. New India Publishing Agency,New Delhi
2. Neeraj Pratap Singh, 2007. Basic Concepts of Vegetable Science. International Book Distributing Co. New Delhi, Academic Press, New Delhi.
3. Nempal Singh, Singh,D.K., Singh, Y.K. and Virendra Kumar. 2006. Vetetable Seed Production Technology. Internaltional Book Distributing Co. Lucknow.
4. Prem Singh Arya and S.Prakash 2002. Vetetables Growing in India. Kalyani publishers, New Delhi.
5. Bose,T.K., Kabir,J.,Maity T.K., Parthasarathy V.A., and Som M.G., 2002. Vegetable Crops Vol I,II& III NayaProkash, Kolkata.
6. Shanmugavelu,K.G.,N.Kumar and K.V.Peter 2005, Production Technology of Spices and Plantation Crops. Agrobios(India), Jodhpur.

Course title: Environmental Studies and Disaster Management

Course Code: 1280012324

Type	Code	Credit	Credit division					Total no of lecture
			L	T	P	SW	FW	
Compulsory		3 (2+1)	32		1		15	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

Multidisciplinary nature of environmental studies Definition, scope and importance. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following

ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Environmental Pollution: definition, cause, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Disaster Management

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to mitigate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

Practical

Pollution case studies. Case Studies- Field work: Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site- Urban/Rural/Industrial/ Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

A.THEORY

Learning objectives:

1. *To learn about environmental studies*
2. *To learn about ecosystem, biodiversity and its conservation*
3. *To learn about natural disasters and their management*

Prerequisite: Classroom, Field visit programme

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
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<p>Module-I: Multidisciplinary nature of environmental studies Definition, scope and importance. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.</p>	9	28
<p>Module-II: Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.</p>	7	22
<p>Module-III: Environmental Pollution: definition, cause,</p>	9	28

<p>effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. dies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.</p>		
<p>Module-IV: Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other</p>	7	22

organizations.		
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Course learning outcome:

CO1: Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving. Interdisciplinary branches of environment and their scopes.

CO2: Concepts of natural resources, Food resources, mineral resources, Concept of non Conventional energy resources, types and various applications of renewable resources and current potentials of energy resources.

CO3: Ecosystem Links between environmental components and their role and types of ecosystems.

CO4: Types of biodiversity, their values, depletion and conservation methods.

CO5: Basic Structure of atmosphere and their functions Current problems related issues context in solving environmental issues such as environmental health, food and agriculture, energy, waste and pollution, climate change, management, Basic knowledge about water recourses, current problems related issues, water born diseases, technologies of water treatment.

CO6: Composition of solid waste, sources of generation, collection and disposal methods of solid waste, recycling, reuse of wastes.

CO7: Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion.

CO8: Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

CO9: Meaning and nature of natural disasters, their types and effects and management

Pedagogy for Course Delivery: *This course offers a good scope for students will be able to understand the relationship between science and society and will be able to learn about environmental studies. Students will learn about ecosystem, biodiversity and its conservation. Students will learn about natural disasters and their management.*

List of Professional Skill Development Activities (PSDA)

2. Awareness programme
3. Work shop, campaign

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL(total contact hours, hr/week), if applicable

Learning objectives:

1. To document environmental assets
2. To visit a local polluted site and local area to document environmental assets
3. To study the environmental component

Total no. of practical	Total contact hour	Contact hour/week
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16	32	2
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List of practical

- Practical-1: Study of River pollution and case studies
- Practical-2: Study of forest pollution and case studies
- Practical-3: Visit to a local area to document environmental assets river
- Practical-4: Visit to a local area to document environmental assets forest/ grassland
- Practical-5: Visit to a local area to document environmental assets hill/ mountain
- Practical-6: Visit to a local polluted site-Urban/Rural
- Practical-7: Visit to a local polluted site- Industrial/Agricultural
- Practical-8: Study of common plants, insects, birds
- Practical-9: Study of simple ecosystems-pond, river
- Practical-10: Study of simple ecosystems hill slopes

Continuous assessment: Quiz/assessment/identification/problem solving etc.

Text & Reference books:

S. No	Name	Author(S)	Publisher
1	Environment Education and Disaster Management	V D Harma	CBS Publisher and Distributors, New Delhi
2	Environment Engineering and Disaster Management	Sanjay K Sharma	Laxmi Publisher

Course title: Statistical Methods

Course Code: 1280012327

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2 (1+1)	1		1			0	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion, Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions, Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. Introduction to Test of Significance, one sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 × 2 Contingency Table. Introduction to Analysis of Variance, Analysis of one-way classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.

Practical

Graphical Representation of Data. Measures of Central Tendency (Ungrouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Central Tendency (Grouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Dispersion (Ungrouped Data). Measures of Dispersion (Grouped Data). Moments, Measures of Skewness & Kurtosis (Ungrouped Data). Moments, Measures of Skewness & Kurtosis (Grouped Data). Correlation & Regression Analysis. Application of One Sample t-test. Application of Two Sample Fisher's t-test. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2×2 contingency table. Analysis of Variance One Way Classification. Analysis of Variance Two Way Classification. Selection of random sample using Simple Random Sampling.

A. THEORY

Learning objectives:

1. *To summarize and present data numerically and visually.*
2. *To have the ability to think critically about data-based claims and quantitative arguments.*

Prerequisite: Software, computer, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module I: Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion.	3	19
Module-II: Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions, Definition of Correlation.	4	25
Module-III: Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. Introduction to Test of Significance, one sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 × 2 Contingency Table.	4	25
Module-IV: Introduction to Analysis of Variance, Analysis of one-way classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.	5	31

- **Course learning outcome:**

CO1: *To apply statistical methods and hypothesis testing to business problems.*

CO2: *To attain a solid information on the basics of statistics and its use in agriculture.*

CO3: *To know about the methods to represent the graphical data of their analysis.*

CO4: *To acquire knowledge on analysis of variance.*

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board.

PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To learn about the basics of statistics and its use in agriculture.
2. To represent the graphical data of analysis.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Graphical Representation of Data.

Practical-2: Measures of Central Tendency (Ungrouped data).

Practical 3: Calculation of Quartiles and Deciles.

Practical 4: Calculation of Percentiles.

Practical 5: Measures of Dispersion (Ungrouped Data).

Practical 6: Measures of Dispersion (Grouped Data).

Practical 7: Moments, Measures of Skewness & Kurtosis (Ungrouped Data).

Practical 8: Moments, Measures of Skewness & Kurtosis (Grouped Data).

Practical 9: Correlation & Regression Analysis.

Practical-10: Application of One Sample t-test.

Practical 11: Application of Two Sample Fisher's t-test.

Practical 12: Chi-Square test of Goodness of Fit.

Practical 13: Chi-Square test of Independence of Attributes for 2×2 contingency table.

Practical 14: Analysis of Variance One Way Classification.

Practical 15: Analysis of Variance Two Way Classification.

Practical 16: Selection of random sample using Simple Random Sampling.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

7. Gupta S P. 2012. *Statistical Methods*. S Chand Publisher.
8. Gupta S C and Kapoor V K. *Fundamentals of Mathematical Statistics*. 1989. Pearson Education.

Course title: Livestock and Poultry Management

Course Code: 1280012323

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		4 (3+1)	3		1			1	64

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
80	5

Component:

Theory

Role of livestock in the national economy. Reproduction in farm animals and poultry; Housing principles, space requirements for different species of livestock and poultry. Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding. Management of growers and layers.

Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry; Improvement of farm animals and poultry.

Digestion in livestock and poultry. Feeding of livestock and poultry. Classification of feedstuffs. Proximate principles of feed. Nutrients and their functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives.

Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry.

Practical

External body parts of cattle, buffalo, sheep, goat, swine and poultry. Handling and restraining of livestock. Identification methods of farm animals and poultry. Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records. Judging of cattle, buffalo and poultry. Culling of livestock and poultry. Planning and layout of housing for different types of livestock. Computation of rations for livestock. Formulation of concentrate mixtures. Clean milk production, milking methods. Hatchery operations, incubation and hatching equipments. Management of chicks, growers and layers. Debeaking, dusting and vaccination. Economics of cattle, buffalo, sheep, goat, swine and poultry production.

A. THEORY

Learning objectives:

To meet the basic and overall knowledge requirement of the students, the extension workers and the progressive farmers on various livestock specifically the farm animals including poultry with respect to physiological and reproductive system.

To expertise on the housing system, feeding requirements, feeding habits and use of low-cost feed technology for better economic return.

To gather knowledge on basic concepts on different disease encountered in the farm animal and poultry and their preventive and control measures, undertaking entrepreneurship in the livestock and poultry sector.

To understand the importance and contribution of livestock in the state and national economy is the primary goal of the study.

Prerequisite: Software, computer, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Role of livestock in the national economy	4	8
Module-II: Reproduction in farm animals and poultry; Housing principles, space requirements for different species of livestock and poultry	8	17
Module-III: Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching	6	12

and brooding. Management of growers and layers		
Module-IV: Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry; Improvement of farm animals and poultry	10	21
Module-V: Digestion in livestock and poultry. Feeding of livestock and poultry. Classification of feedstuffs. Proximate principles of feed. Nutrients and their functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives.	11	23
Module-VI: Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry	9	19

• **Course learning outcome:**

CO1: To understand the operation of livestock and poultry farming as a major component of integrated farming system in agriculture.

CO2: To interpret the knowledge of animal reproduction and housing principles to provide a sustainable source of income and generate employment opportunity in rural areas.

CO3: To explain different options of management of farm animals and poultry birds.

CO4: To explain how different animal breeds perform and how to improve their performances.

CO5: Evaluate the relevant information of animal nutrition and disease management to harness the maximum potential of animal production.

CO6: Evaluate the relevant information of disease management to help the person in animal husbandry sector in harnessing the maximum potential of good animal health.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board.

PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

1. Techniques of carrying out livestock and poultry farming.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To interpret the knowledge of handling, restraining, judging, culling, nutrition routine farm operations of farm animals to provide a sustainable source of income and generate employment opportunity in rural areas.

2. To develop the skill of economizing farm animal and poultry production for improving the livelihood of farming community.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical 1: External body parts of cattle and buffalo.

Practical 2: External body parts of sheep and goat.

Practical 3: External body parts of swine and poultry.

Practical 4: Handling and restraining of livestock.

Practical 5: Identification methods of farm animals and poultry.

Practical 6: Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records.

Practical 7: Judging of cattle, buffalo and poultry.

Practical 8: Culling of livestock and poultry.

Practical 9: Planning and layout of housing for different types of livestock.

Practical 10: Computation of rations for livestock.

Practical 11: Formulation of concentrate mixtures.

Practical 10: Clean milk production, milking methods.

Practical 12: Hatchery operations, incubation and hatching equipments.

Practical 13: Management of chicks, growers and layers.

Practical 14: Debeaking, dusting and vaccination.

Practical 15: Economics of cattle, buffalo and sheep production.

Practical 16: Economics of goat, swine and poultry production.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. *Banerjee, G. C. (2018). A textbook of animal husbandry. Oxford and IBH publishing.*
2. *Ghosh, N. (2019). Livestock production management. PHI Learning Pvt. Ltd.*
3. *Sastry, N. S. R., Thomas, C. K., & Singh, R. A. (1982). Farm animal management and poultry production. Vikas Publishing House.*
4. *Singh, R. (1998). Essentials of animal production and management. Kalyani Publishers.*
5. *Bhalerao, V. R. (1985). Handbook of Animal Husbandry. ICAR, New Delhi. Revised ed.*

Semester IV

Course title: Crop Production Technology-II (Rabi Crops)

Course Code: 1280013328

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2 (1+1)	16		16			5	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rabi crops; cereals – wheat and barley, pulses- chickpea, lentil, peas, oilseeds-rape seed, mustard and sunflower; sugar crops-sugarcane; medicinal and aromatic crops- mentha, lemon grass and citronella, Forage crops- berseem, lucerne and oat.

Practical

Sowing methods of wheat and sugarcane, identification of weeds in rabi season crops, study of morphological characteristics of rabi crops, study of yield contributing characters of rabi season crops, yield and juice quality analysis of sugarcane, study of important agronomic experiments of rabi crops at experimental farms. Study of rabi forage experiments, oil extraction of medicinal crops, visit to research stations of related crops.

A. THEORY

Learning objectives:

To teach the crop husbandry of cereals, forage, fibers, oil seed and pulse crops.

Prerequisite: Land, lab, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Kharif crops. Cereals – wheat and barley.	3	18
Module-II: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Kharif crops. Pulses- chickpea, lentil, peas.	7	45
Module-III: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Kharif crops. Oilseeds- rapeseed, mustard and sunflower.	2	12
Module-IV: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and	4	25

yield of Kharif crops. sugar crops-sugarcane; medicinal and aromatic crops-mentha, lemon grass and citronella, Forage crops-berseem, lucerne and oat.		
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Course learning outcome: On successful completion of this course students will be able to

CO1: Learn the origin, geographical distribution and economic importance of rabi crops.

CO2: Learn the soil and climatic requirements, varieties of rabi crop.

CO3: Learn the cultural practices of rabi crop.

Pedagogy for Course Delivery: Power point presentation, Verbal presentation by Using white board and marker

List of Professional Skill Development Activities (PSDA)

1. Demonstrate an ability to work effectively with others.
2. Recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable decisions.
3. A fundamental understanding of economic principles and their application to agricultural, resource, rural and related issues.
4. Knowledge dissemination regarding various technique of farming and farming system, types of market and marketing of agricultural produce.
5. Acquire the ability to engage in independent and life-long learning in the ever-changing agricultural production system/enterprises.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

To teach the crop husbandry of cereals, forage, fibers, oil seed and pulse crops.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

- Practical-1: Sowing methods of wheat.
- Practical-2: Sowing methods of sugarcane.
- Practical-3: Sowing methods of barley.
- Practical-4: Sowing methods of chick pea.
- Practical-5: Sowing methods of lentil.
- Practical-6: Sowing methods of pea.
- Practical-7: Sowing methods of mustard.
- Practical-8: Sowing methods of sunflower.
- Practical-9: Sowing methods of rapeseed.
- Practical-10: Identification of weeds in rabi season crops.
- Practical-11: Study of morphological characteristics of rabi crops.
- Practical-12: Study of yield contributing characters of rabi season Crops
- Practical-13: Yield and juice quality analysis of sugarcane.
- Practical-14: Study of important agronomic experiments of rabi crops at experimental farms.
- Practical-15: Study of rabi forage experiments, oil extraction of medicinal Crops.

Practical-16: Visit to research stations of related crops.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Reddy, S.R. and ReddiRamu. 5th edition. *Agronomy of Field Crops*, Kalyani Publishers, Ludhiana.
2. Chidda Singh, Singh, P. and Singh, R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Rajendra Prasad (ed.), 2004. *Text Book of Field Crop Production, Commercial Crops, Volume -II*. ICAR, New Delhi. </p>ure : concept and numerical Amit Bhatnagar
4. Singh, S.S. 1998, *Crop Management: Under irrigated and rainfed conditions*.
5. Singh, S.S. 1993, *Principles and Practices of Agronomy*, Kalyani Publishers, New Delhi.
6. Reddy,T.Y. and Reddi, G.H.S. 1993. *Principles of Agronomy*, Kalyani Publishers, New Delhi.
7. Maiti, S. , Hedge,M.R. and Chhattachopadhyay, S.B. 1988. *Handbook of Annual Oil Seed Crops*. Oxford & IBH Publishing Co., New Delhi.
8. Jaiswami, L.H. and Baldeo, B. 1990. *Advances in Puulse Production Technology*, ICAR, New Delhi.
9. Thakur, C. 1979. *Crop Production, Vol. I & II*. Metropolitan Book Pvt. Ltd., New Delhi.
10. Ahlawat, I.P.S. , Sharma, O.P. & Saini., G.S. 1998 *Scientific Crop Production in India*. Aman Publishing House, Madhu Market, Budhana gate, Meerut.
11. Rathore, P.S. 1999-2000. *Techniques and Management of Field Crop Production*. Agrobios (India), Jodhpur.
12. Rathore, P.S. and Sharma, S.K. 2003. *Scientific Pulse Production*. Yash Publishing House, Bikaner.
13. Sharma, Kalicharan 1990 *Bharat ki promokh faslea*. G.B. Pant Agricultural & Technology University, Nanital.
14. Reddy, S.R. 2004. *Agronomy of Field Crops*. Kalyani Publishers, New Delhi.

Course title: Production Technology for Ornamental Crops, MAP and Landscaping.

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2 (1+1)	16		16		12	2	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers. Production technology of important cut flowers like rose, gerbera, carnation, liliun and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions. Package of practices for loose flowers like marigold and jasmine under open conditions. Production technology of important medicinal plants like asparagus, aloe, costus, Cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver. Processing and value addition in ornamental crops and MAPs produce.

Practical

Identification of Ornamental plants. Identification of Medicinal and Aromatic Plants. Nursery bed preparation and seed sowing. Training and pruning of Ornamental plants. Planning and layout of garden. Bed preparation and planting of MAP. Protected structures – care and maintenance. Intercultural operations in flowers and MAP. Harvesting and post harvest handling of cut and loose flowers. Processing of MAP. Visit to commercial flower/MAP unit.

A. THEORY

Learning objectives:

- a. To know Importance and scope of Ornamental Crops, MAPs and Landscaping.
- b. To incorporate the Knowledge about production technology of cut flower, loose flower, medicinal and aromatic plants.
- c. To know the Uses of tree, shrub, climbers, potted plants in landscaping.
- d. To know the Processing and value addition in ornamental plants and MAPs produce.

Prerequisite: Land, lab, Classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers	5	32
Module-II: Production technology of important cut flowers like rose, gerbera, carnation, liliun and orchids under protected condition sand gladiolus, tuberose, chrysanthemum under open conditions.	5	32
Module-III: Package of practices for loose flowers like marigold and jasmine under open conditions. Production technology of important medicinal plants like ashwagandha, asparagus, aloe, costus, cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver.	5	32
Module-IV: Processing and value addition in ornamental crops and MAPs produce.	1	4

Course learning outcome:

CO1: Students will be able to understand the scientific cultivation practices of different types of ornamental crops.

CO2: Students will be able to understand the Herbal industry, Indian system of medicine, indigenous Traditional Knowledge, IPR issues, Classification of medicinal crops, Systems of cultivation, Organic Production, Role of institutions and NGO's in production, GAP in medicinal crops production.

CO3: Students will be able to understand familiarization with principles and practices of landscaping of garden.

CO4: Student will be able to apply planning and layout of different types of garden.

Pedagogy for Course Delivery: verbal presentation with power point.

List of Professional Skill Development Activities (PSDA)

1. To know the production technology of different types of ornamental crops and medicinal & aromatic crops.
2. To know the proper layout of garden.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To know the production technology of different types of ornamental crops.
2. To know the landscaping of different places.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Identification of ornamental plants.

Practical-2: Identification of Medicinal and Aromatic Plants.

Practical-3: Nursery bed preparation and flower seed sowing

Practical-4: Training and pruning of roses.

Practical-5: Planning and layout of ornamental garden.

Practical-6: Bed preparation and planting of Medicinal and Aromatic Plants.

Practical-7: Protected structures – Care and maintenance.

Practical-8: Intercultural operations in flowers crops.

Practical-9: Intercultural operations in Medicinal and Aromatic plants.

Practical-10: Harvesting and post harvest handling of cut and loose flowers.

Practical-11: Floral preservatives to prolong vase-life of cut flowers.

Practical-12: Drying / dehydration techniques for flower drying.

Practical-13: Processing of Medicinal and Aromatic Plants.

Practical-14: Extraction of essential oils.

Practical-15: Visit to commercial flower unit.

Practical-16: Visit to commercial MAP unit.

Continuous assessment: Viva-voce/assessment etc.

Text & Reference books:

1. Bose T.K.1999. floriculture and Landscaping. NayaPrakash, Kolkatta.
2. Bose, T.K. and Yadav, L.P. 1992. Commercial Flowers. NayaPrakash, Kolkatta

- Randhawa, G.S. and Mukhopadhyaya, A.1994. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.
- Chattopadhyay, S.K. 2007. Commercial Floriculture. Gene-Tech Books, New Delhi
- Srivastava, H.C. 2014. Medicinal and Aromatic Plants, ICAR, New Delhi.
- Kumar, N., Abdul Khader, J.B.M., Rangaswamy, P and Irulappan, I. 2004. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Crops. Oxford and IBH publishing Co., New Delhi.

Course title: Renewable Energy and Green Technology

Course Code: 1280013334

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2(1+1)	16		16			2	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory:

Classification of energy sources, contribution of these of sources in agricultural sector, Familiarization with biomass utilization for biofuel production and their application, Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as bioenergy resource, introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application, introduction of wind energy and their application.

Practical:

Familiarization with renewable energy gadgets. To study biogas plants, To study gasifier, To study the production process of biodiesel, To study briquetting machine, To study the production process of bio-fuels. Familiarization with different solar energy gadgets. To study solar photovoltaic system: solar light, solar pumping, solar fencing. To study solar cooker, To study solar drying system. To study solar distillation and solar pond.

A. THEORY

Learning objectives:

- To know the basics of energy sources and contribution of these of sources in agricultural sector*
- To understand the different kind of renewable energy.*
- To enhances the knowledge of biogas and biofuel and design the biogas plant.*
- To create knowledge about solar energy gadgets and wind energy application.*

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Classification of energy sources, contribution of these of sources in agricultural sector,	2	12.50

Module-II: Familiarization with biomass utilization for biofuel production and their application, Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production.	4	25.00
Module-III: Utilization as bioenergy resource, introduction of solar energy, collection and their application.	4	25.00
Module-IV: Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application.	4	25.00
Module-V: Introduction of wind energy and their application.	2	12.50

Course learning outcome:

CO1: Understand about energy sources in India and the contribution in agricultural sector.

CO2: Design and improved knowledge of Biogas plant and biofuel.

CO3: Analysis and understand the different solar energy utilization and solar energy gadgets.

CO4: Application of wind energy

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

1. Design and development of biogas plant.
2. Mechanism and utilization of solar energy gadgets.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. Understand the basic concepts of the ultrastructure of different renewable energy resource utilization.
2. Design and application of biogas plant, biofuel and solar energy gadget etc

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

- Practical-1 Familiarization with renewable energy gadgets.
Practical-2 To study biogas plants,
Practical-3 To study gasifier,
Practical-4 To study the production process of biodiesel,
Practical-5 To study briquetting machine,
Practical-6 To study the production process of bio-fuels.
Practical-7 Familiarization with different solar energy gadgets.
Practical-8 To study solar photovoltaic system: solar light, solar pumping, solar fencing.
Practical-9 To study solar cooker,
Practical-10 To study solar drying system.,
Practical-11 To study solar distillation and solar pond

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Energy Technology (Non-Conventional, Renewable and Conventional) by Rao Khanna, Khanna Publishers.
2. Renewable Energy and Green Technology: Principles and Practices by [Narendra Kumar](#), [Hukum Singh](#), [Amit Kumar](#), CRC Press

Course title: Problematic Soils and their Management

Course Code: 1280013329

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2 (2+0)	32					2	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
32	2

Component:

Theory

Soil quality and health, Distribution of Waste land and problem soils in India. Their categorization based on properties. Reclamation and management of Saline and sodic soils, Acid soils, Acid Sulphate soils, Eroded and Compacted soils, Flooded soils, Polluted soils.

Irrigation water – quality and standards, utilization of saline water in agriculture.

Remote sensing and GIS in diagnosis and management of problem soils.

Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agro ecosystems.

A. THEORY

Learning objectives:

1. To understand the extent of problematic soils in the country and their characters
2. To explain the reclamation measures of different problematic soils existing in India
3. To interpret the quality of irrigation water for safe agricultural use
4. To interpret the use of remote sensing and GIS in managing problem soil
5. To evaluate the land capabilities and tree species under different agro-ecosystems

Prerequisite: Classroom, Markers, White board

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Soil quality and health, Distribution of Waste land and problem soils in India. Their categorization based on properties.	5	15.60
Module-II: Reclamation and management of Saline and sodic soils, Acid soils, Acid Sulphate soils, Eroded and Compacted soils, Flooded soils, Polluted soils.	12	37.50
Module-III: Irrigation water – quality and standards, utilization of saline water in agriculture.	5	15.60
Module-IV: Remote sensing and GIS in diagnosis and management of problem soils.	5	15.60
Module-V: Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agro-ecosystems	5	15.60

Course learning outcome:

CO1: Understand the extent of problematic soils in the country and their characters

CO2: Explain the reclamation measures of different problematic soils existing in India

CO3: Interpret the quality of irrigation water for safe agricultural use

CO4: Interpret the use of remote sensing and GIS in managing problem soil

CO5: Evaluate the land capabilities and tree species under different agro-ecosystems

Pedagogy for Course Delivery:

List of Professional Skill Development Activities (PSDA):

1. Problem soil management
2. Degraded soil reclamation method.

Continuous assessment : Quiz/assessment/presentation/problem solving etc.

Course title: Production technology of fruits and plantation crops

Course Code: 1280013132

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2 (1+1)	16		6		10	2	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Importance and scope of fruit and plantation crop industry in India; High density planting; Use of rootstocks; Production technologies for the cultivation of major fruits-mango, banana, citrus, grape, guava, litchi, papaya, apple, pear, peach and; minor fruits-pineapple, pomegranate, jackfruit, strawberry, nut crops; plantation crops-coconut, arecanut, cashew, tea, coffee & rubber.

Practical

Seed propagation. Scarification and stratification of seeds. Propagation methods for fruit and plantation crops including Micro-propagation. Description and identification of fruit. Preparation of plant bio regulators and their uses, Pests, diseases and physiological disorders of above fruit and plantation crops, Visit to commercial orchard.

A. THEORY

Learning objectives:

1. To know about the production technology for fruits and plantation crops.
2. Students will assess and modify cultural practices used in the production of vegetable crops, including the integration of soil science, plant physiology, plant nutrition, agro meteorology and crop protection

Prerequisite: Land, lab, Classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Importance and scope of fruit and plantation crop industry in India; Importance of rootstocks; Production technologies for the cultivation of major fruits.	4	25
Module-II: Production technology of Mango, banana, citrus, grape, guava, litchi, papaya, sapota, apple, pear, peach, walnut, almond.	4	25
Module-III: Production technology of Minor fruits- date, ber, pineapple, pomegranate, jackfruit, strawberry.	4	25
Module-IV: Production technology of Plantation crops-coconut, areca nut, cashew, tea, coffee & rubber.	4	25

Course learning outcome:

CO1: Students will be able to understand the scientific cultivation methods such as time and methods of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield of different fruit crops

CO2: Students will be able to understand the scientific cultivation methods such as time and methods of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield of different plantation crops.

CO3: Students will be able to apply different propagation techniques in fruit crops.

CO4: Students will be able to understand the concept of High density plantation in different fruit crops.

Pedagogy for Course Delivery: verbal presentation with power point.

List of Professional Skill Development Activities (PSDA)

1. To know the production technology of different types of fruits and plantation crops.
2. Understand and analyze the factors that affect the distribution of the industry of fruits and plantation crops at the global to regional levels, from small community and roof-top gardens to large acreage, commercial production for local consumption, processing and export.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To know the production technology of different types of fruits and plantation crops.
2. To know the propagation of different fruits crops.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Study and identification of different fruits crops

Practical-2: Study and identification of different plantation crops

Practical-3: Study about the seed Propagation of fruits and plantation crops

Practical-4: Study about different types of cutting methods in fruit and plantation crops by cutting.

Practical-5: Study about different types of Layering of fruits and plantation crops

Practical-6: Study about different types of grafting techniques used in propagation of fruits and plantation crops

- Practical-7: Study about different types of budding techniques used in propagation of fruits and plantation crops
 Practical-8: Study about seed Scarification and Stratification fruits and plantation crops
 Practical-9: Study about the preparation of growth regulators and its application in fruits and plantation crops
 Practical-10: Study about the physiological disorders in fruits crop.
 Practical-11: Study about the physiological disorders in fruits crop.
 Practical-12: Study about the different diseases of fruits and plantation crops
 Practical-13: Study about the different pests of fruits crops
 Practical-14: Study about the different pests of plantation crops
 Practical-15: Seed propagation-Scarification and stratification of seeds
 Practical-16: Visit to commercial plantations/ fruit orchards

Continuous assessment: Viva-voce/assessment etc.

Text & Reference books:

1. Bose, T.K. and Mitra, S.K. 1990. fruits-Tropical and Sub-tropical. NayaPrakashan, Calcutta.
2. Chattopadhyaya, P.K. Year. Text Book on Pomology (Fundamentals of Fruit Growing). Kalyani Publishers, Ludhiana.
3. Bijendra Singh. 2012. Horticulture at a Glance. Kalyani Publishers, Ludhiana.
4. Parthasarathy, V.A., P.K. Chattopadhyay and Bose, T.K. 2006. Plantation Crops. Vol I and II. Parthasankarbasu Naya Udyog, Kolkata.
5. Kumar, N., Abdul Khader, J.B.M., Rangaswamy, P. and Irulappan, I. 2004. Introduction to Spices, Plantation crops, Medicinal and Aromatic Crops. Oxford and IBH Publishing Co., New Delhi

Course title: Principles of Seed Technology

Course Code: 1280013330

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		3(1+2)	16		32			4	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory:

Seed and seed technology: introduction, definition and importance. Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production, seed quality; Definition, Characters of good quality seed, different classes of seed. Foundation and certified seed production of important cereals, pulses, oilseeds, fodder and vegetables. Seed certification, phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, Varietal Identification through Grow Out Test and Electrophoresis, Molecular and Biochemical test. Detection of genetically modified crops, Transgene contamination in non-GM crops, GM crops and organic seed production. Seed

drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing. Private and public sectors and their production and marketing strategies.

Practical:

Seed production in major cereals: Wheat, Rice, Maize, Sorghum, Bajra and Ragi. Seed production in major pulses: Urd, Mung, Pigeonpea, Lentil, Gram, Field bean, pea. Seed production in major oilseeds: Soybean, Sunflower, Rapeseed, Groundnut and Mustard. Seed production in important vegetable crops. Seed sampling and testing: Physical purity, germination, viability, etc. Seed and seedling vigour test. Genetic purity test: Grow out test and electrophoresis. Seed certification: Procedure, Field inspection, Preparation of field inspection report. Visit to seed production farms, seed testing laboratories and seed processing plant.

A. THEORY

Learning objectives:

1. *This course will enhance the knowledge of seed biology, seed quality, seed production, seed storage and seed certification. This course is designed to strengthen undergraduate student in the field of seed science & technology and to initiate basic research related to genetic purity, seed health and seed storage.*
2. *It ensures physical quality through processing pervades quality checks through certification norms and finally reaches the farmer as a enhanced input ensuring assured returns.*
3. *Seed enhancement techniques like pelleting, priming and coating are provided for improved knowledge. On completion, one can possess sufficient knowledge on seed quality, its production strategy, processing methodology, distribution links and even legal issues.*

Prerequisite: Well-equipped laboratory, white board and marker, classroom with projector.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Seed and seed technology: introduction, definition and importance. Deterioration causes of crop varieties and their control. Maintenance of genetic purity during seed production. Seed quality: Definition, characters of good quality seed, different classes of seed.	4	25
Module-II: Foundation and certified seed production of important cereals, pulses, oilseeds, fodder and vegetables. Seed certification, phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties.	4	25
Module-III: Seeds Control Order 1983, Varietal Identification through Grow Out Test and Electrophoresis, Molecular and Biochemical test. Detection of genetically modified crops, Transgene contamination in non-GM crops, GM crops and organic seed	4	25

production. Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing.		
Module-IV: Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing. Private and public sectors and their production and marketing strategies	4	25

Course learning outcome:

CO1: Understand various aspects of seed technology such as quality, production, multiplication, certification, testing, processing, storage and marketing

CO2: Students will become aware of different legislative measures which regulate production and sale of seeds in India

CO3: Helpful in acquiring knowledge in seed production technology and marketing i.e useful for developing entrepreneurs among students

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

1. Assessment of purity and maintenance of purity of seed lot using conventional and molecular techniques.
2. Quality seed production techniques of various crops.
3. Assessment of seed vigour
4. Field inspection techniques in detail

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To enhance the knowledge about seed biology, seed quality, seed production, seed storage and seed certification
2. To make students aware about seed processing, seed testing and quality seed production techniques.

Total no. of practical	Total contact hour	Contact hour/week
32	64	4

List of practical

Practical-1: Seed production in major cereals: Wheat

Practical-2: Seed production in major cereals: Rice

Practical-3: Seed production in major cereals: Maize

Practical-4: Seed production in major cereals: Sorghum, Bajra

Practical-5: Seed production in major cereals: Ragi

Practical-6: Seed production in major pulses: Urd

Practical-7: Seed production in major pulses: Mung

Practical-8: Seed production in major pulses: Pigeonpea

Practical-9: Seed production in major pulses: Lentil

- Practical-10: Seed production in major pulses: Gram
 Practical-11: Seed production in major pulses: Field bean, pea.
 Practical-12: Seed production in major oilseeds: Soybean
 Practical-13: Seed production in major oilseeds: Sunflower
 Practical-14: Seed production in major oilseeds: Rapeseed
 Practical-15: Seed production in major oilseeds: Groundnut
 Practical-16: Seed production in major oilseeds: mustard
 Practical-17: Seed production in important vegetable crops-Part 1
 Practical-18: Seed production in important vegetable crops-Part 2
 Practical-19: Seed production in important vegetable crops-Part 3
 Practical-20: Study about seed sampling techniques
 Practical-21: Determination of Physical purity
 Practical-22: Determination of germination percentage
 Practical-23: Determination of viability percentage
 Practical-24: Seed and seedling vigour test
 Practical-25: Genetic purity test: Grow out test
 Practical-26: Genetic purity test: Electrophoresis
 Practical-27: Seed certification: Procedure
 Practical-28: Study of Field inspection
 Practical-29: Preparation of field inspection report.
 Practical-30: Visit to seed production farms
 Practical-31: Visit to seed testing laboratories
 Practical-32: Visit to seed processing plant.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Principles of Seed Technology by P. K. Agawal; Directorate of Information and Publications of Agriculture, ICAR, New Delhi.
2. Principles of Seed Technology by B. L. Jana; Aavishkar Publishers, Distributors, Jaipur.
3. Advances in Seed Science and Technology by Laxmi Narayan; Anmol Publications Pvt. Ltd.

Course title: Farming System and Sustainable Agriculture

Course Code: 1280013135

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		1 (1+0)	16					1	16

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
16	1

Component:

Theory

Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance, Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Allied enterprises and their importance, Tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability, Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages, Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques, Resource cycling and flow of energy in different farming system, farming system and environment, Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers field.

A. THEORY

Learning objectives:

1. To educate the students on the relevance of farming systems in present context.
2. Imparting knowledge about sustainable agriculture, conservation agriculture and IFS model.
3. To throw a light on resource cycling, HEIA, LEIA and LEISA.
4. To prepare site specific development of IFS model for different agro-climatic zones.

Prerequisite: Field, Classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance.	4	25
Module-II: Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Allied enterprises and their importance, Tools for determining production and efficiencies in cropping and farming system.	4	25
Module-III: Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability, Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages.	4	25
Module-IV: Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques, Resource cycling and flow of energy in different farming system, farming system and environment, Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers' field.	4	25

Course learning outcome: On successful completion of this course students will be able to

CO1: Earn maximum possible return and profitability.

CO2: Increase economic yield.

CO3: conserve the natural resources while exploiting the boons of the nature for better out come from the resources available all the year round.

Pedagogy for Course Delivery: PowerPoint presentation, white board and marker use.

List of Professional Skill Development Activities (PSDA)

3. site specific development of IFS model for different agro-climatic zones

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Total no. of practical	Total contact hour	Contact hour/week
0	0	0

List of practical

Continuous assessment:

Text & Reference books:

Farming System and Sustainable Agriculture by S S Walia and U S Walia

Farming System and Sustainable Agriculture by S.R. Reddy

Additional reading: Framing System and Sustainable Agriculture by Dr Chandan Singh and Dr. Ravindra Nath

Course title: Agricultural Marketing, Trade and Prices

Course Code: 1280013331

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		3 (2+1)	32	0	16	0	1	4	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; demand, supply and producer's surplus of agri-commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; product life cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits; marketing process and functions: Marketing process-concentration, dispersion and equalization; exchange functions – buying

and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of International Trade in agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR.

Practical

Plotting and study of demand and supply curves and calculation of elasticities; Study of relationship between market arrivals and prices of some selected commodities; Computation of marketable and marketed surplus of important commodities; Study of price behaviour over time for some selected commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning; Application of principles of comparative advantage of international trade.

A. THEORY

Learning objectives:

1. *To learn about the agriculture marketing, trades and prices.*
2. *To create awareness among the students about the role of International Trade and its need in agricultural commodities.*
3. *To enhance expertise in improving the performance of the marketing institutions and the players in marketing of agricultural commodities.*

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; demand, supply and producer's surplus of agri-commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities.	8	25
Module-II: product life cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising,	6	19

personal selling, sales promotion and publicity – their meaning and merits & demerits.		
Module-III: Marketing process-concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (Agmark);Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel;number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs.	10	31
Module-IV: Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of International Trade in agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR.	8	25

Course learning outcome:

CO1: To acquire skill full knowledge in addressing the issues of agricultural marketing process, functions, marketing process-concentration, dispersion, equalization and exchange.

CO2: To understand role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions

CO3: To enhance expertise in improving the performance of the marketing institutions and the players in marketing of agricultural commodities.

CO4: To develop interaction with the farmers and villagers and visit to the local agricultural market.

Pedagogy for Course Delivery: PowerPoint presentation and verbal presentation by using White board and marker.

List of Professional Skill Development Activities (PSDA)

1. *Understand role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions.*
2. *Enhancing expertise in improving the performance of the marketing institutions and the players in marketing of agricultural commodities.*
3. *Understand role, mechanism and value of commodity futures markets for price risk management and price discovery in the Indian commodity markets.*
4. *Interaction with the farmers and villagers and visit to the local agricultural market.*

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. *To Study of price behavior over time for some selected commodities and construction of index numbers.*
2. *To teach Plotting and study of demand and supply curves and calculation of elasticities in market situations.*
3. *To Study of relationship between market arrivals and prices of some selected commodities.*

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Study of law of demand and supply and determination of price equilibrium.

Practical-2: Average revenue sales, total revenue and marginal revenue curve of a firm under perfect competition, monopoly competition and monopolistic competition.

Practical-3: Calculation of elasticity of demand.

Practical-4: Estimation of marketable surplus and marketed surplus for different agricultural commodities.

Practical-5: Study of marketing channels for different crop (Part- I).

Practical-6: Study of marketing channels for different crop. (Part- II)

Practical-7: Study of regulated market.

Practical-8: Study of seasonal indices of arrival and prices of cereals.

Practical-9: Estimation of Marketing cost, Market Margin and Price Spread for food grains

Practical-10: Study of National Agriculture Cooperative Marketing Federation of India. (NAFED)

Practical-11: Study of SWC and CWC.

Practical-12: Application of Principle of Comparative advantage of International Trade.

Practical-13: Study of relationship between market arrivals and prices of some selected commodities.

Practical-14: Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity.

Practical-15: Power Point Presentation in class on various marketing functions performed by different agencies, identification of marketing channels for selected commodity.

Practical-16: Presentation of report in class on visit to cooperative marketing organization, NAFED, SWC/CWC, Regulated Market.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. Acharya, S.S. and Agrawal, N.L. *Agricultural Marketing in India*, Oxford & IBH publishing Co. Pvt Ltd. New Delhi.
2. Kahlon, A.S, and Tyagi R.S., *Agricultural Price Policy in India*, Allied Publishers Private Limited, New Delhi.
3. S. Subba Reddy, P. Raghuram, T. V. Neelakanta Sastry and I. Bhavani Devi. *Agricultural Economics*.

Course title: Introductory Agrometeorology & Climate Change

Course Code: 1280013333

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2 (1+1)	16		16			1	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth; Atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking. Monsoon- mechanism and importance in Indian agriculture, Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave. Agriculture and weather relations; Modifications of crop microclimate, climatic normals for crop and livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture

Practical

Visit of Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording. Measurement of total, shortwave and longwave radiation, and its estimation using Planck's intensity law. Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS. Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis. Measurement of soil temperature and computation of soil heat flux. Determination of vapor pressure and relative humidity. Determination of dew point temperature. Measurement of atmospheric pressure and analysis of atmospheric conditions. Measurement of wind speed and wind direction, preparation of wind rose. Measurement, tabulation and analysis of rain.

Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.

A. THEORY

Learning objectives:

1. To study about different climatic factors affecting crop growth and development.
2. To study about different weather aberrations.
3. To study about climate change, its cause and impacts.
4. To study about weather forecasting.

Prerequisite: Classroom, observatory.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables	2	18
Module-II: Atmospheric pressure, Wind, Solar radiation, solar constant, albedo; Atmospheric temperature, Energy balance of earth; Atmospheric humidity, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation cloud formation and classification	7	46
Module-III: Artificial rainmaking. Monsoon-mechanism and importance in Indian agriculture. Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave.	2	12
Module-IV: Agriculture and weather relations; Modifications of crop microclimate, climatic normals for crop and livestock production. Weather forecasting- types of weather forecast and their uses.	2	12
Module V: Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture	2	12

Course learning outcome: On successful completion of this course students will be able to

CO1: Understand the concept of agrometeorology.

CO2: Understand roles of agrometeorology in agriculture and its relation to other areas of agriculture.

CO3: Acquaint with recent developments in agrometeorology with historical developments.

CO4: Handle Instruments for measuring various weather variables.

Pedagogy for Course Delivery: PowerPoint presentation, white board and marker use.

List of Professional Skill Development Activities (PSDA)

1. *Instrument handling for measuring various weather variables.*

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. *To measure different weather variables (temperature, humidity, pressure, rainfall and others).*
2. *To teach basic handling of various instruments.*
3. *To prepare layout for meteorological observatories.*

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Study of meteorological observatories, site selection and layout.

Practical-2: Measurement of total, shortwave and longwave radiation, and its estimation using Planck's intensity law.

Practical-3: Measurement of albedo and sunshine duration.

Practical-4: computation of Radiation Intensity using BSS.

Practical-5: Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis.

Practical-6: Measurement of soil temperature.

Practical-7: computation of soil heat flux.

Practical-8: Determination of vapor pressure and relative humidity.

Practical-9: Determination of dew point temperature.

Practical-10: Measurement of atmospheric pressure.

Practical-11: analysis of atmospheric conditions.

Practical-12: Measurement of wind speed and wind direction.

Practical-13: Measurement, tabulation and analysis of rain.

Practical-14: Measurement of open pan evaporation and evapotranspiration.

Practical-15: Computation of PET and AET.

Practical-16: Visit of Agrometeorological Observatory.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

Radha Krishna Murthy, V. 2016. Principles and Practices of agricultural disaster management, B.S. Publications, Koti, Hyderabad.

Reddy, S.R. 2014. Introduction to Agriculture and Agrometeorology. Kalyani Publishers, Ludhiana, Punjab.

Additional reading: Radha Krishna Murthy, V. 2002. Basic Principles of Agricultural meteorology, B.S. Publications, Koti, Hyderabad.

Semester V

Course title: Principles of Integrated Pest and Disease Management

Course Code: 1280014338

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		3 (2+1)	2		1			1	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

Categories of insect pests and diseases, IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of insect pests, diseases and pest risk analysis. Methods of detection and diagnosis of insect pest and diseases. Calculation and dynamics of economic injury level and importance of Economic threshold level. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment. Introduction to conventional pesticides for the insect pests and disease management. Survey surveillance and forecasting of Insect pest and diseases. Development and validation of IPM module. Implementation and impact of IPM (IPM module for Insect pest and disease. Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programmes. Case histories of important IPM programmes.

Practical

Methods of diagnosis and detection of various insect pests, and plant diseases, Methods of insect pests and plant disease measurement, Assessment of crop yield losses, calculations based on economics of IPM, Identification of biocontrol agents, different predators and natural enemies. Mass multiplication of *Trichoderma*, *Pseudomonas*, *Trichogramma*, NPV etc. Identification and nature of damage of important insect pests and diseases and their management. Crop (agroecosystem) dynamics of a selected insect pest and diseases. Plan & assess preventive strategies (IPM module) and decision making. Crop monitoring attacked by insect, pest and diseases. Awareness campaign at farmer's fields.

A. THEORY

Learning objectives:

Main objective of this course is to familiarize the students about the integrated approach of pest and disease management of the crops other than chemical management of pests & diseases of plants.

Prerequisite: Classroom & well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Categories of insect pests and diseases, IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of insect pests, diseases and pest risk analysis. Methods of detection and diagnosis of insect pest and diseases.	9	28
Module-II: Calculation and dynamics of	12	39

economic injury level and importance of Economic threshold level. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment.		
Module-III: Introduction to conventional pesticides for the insect pests and disease management. Survey surveillance and forecasting of Insect pest and diseases. Development and validation of IPM module.	5	15
Module-IV: Implementation and impact of IPM (IPM module for Insect pest and disease). Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programmes.	6	18

Course learning outcome:

CO1: Students will learn the importance of studying the disease cycles

CO2: To Students will learn different types of symptoms during infection by various types of pathogens and the role of weather and disease forecasting before the spread of epidemics

CO3: To aware the students about the harmful effects of chemical pesticides in environment and develop their knowledge about various non-chemical approaches of pest control.

CO4: Students will learn prevention and control measures during the disease spread, disease cycle and integrated pest managements of different crops.

Pedagogy for Course Delivery:

List of Professional Skill Development Activities (PSDA)

- Visit to the Central Integrated Pest Management Centre, Govt. of India to train the students about production of biopesticides, how to maintain biocontrol agents and also their use in agriculture.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives

Main objective of this course is to familiarize the students about the integrated approach of pest and disease management of the crops other than chemical management of pests & diseases of plants.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Methods of diagnosis and detection of various insect pests, and plant diseases.

Practical-2: Methods of insect pests and plant disease measurement.

Practical-3: Assessment of crop yield losses, calculations based on economics of IPM

Practical-4: Identification of biocontrol agents, different predators and natural enemies Practical-5:

Mass multiplication of *Trichoderma*,

Practical-6: Mass multiplication of *Pseudomonas*

Practical-7: Mass multiplication of *Trichogramma*.

Practical-8: Mass multiplication of NPV.

Practical-9: Identification and nature of damage of important insect pests and diseases and their management.

Practical-10: Crop (agro-ecosystem) dynamics of a selected insect pest and diseases.

Practical-11: Plan & assess preventive strategies (IPM module) and decision making.

Practical-12: Study of phanerogamic plant parasites.

Practical-13: Study of fungicides and their formulations.

Practical-14: Methods of pesticide application and their safe use.

Practical-15: crop monitoring attacked by insect, pest and diseases.

Practical-16: Awareness campaign at farmer's fields.

Continuous assessment: Quiz/assessment/identification/problem solving etc.

Text & Reference books:

Integrated Pest Management -concepts and Approaches by G S Dhaliwal and R Arora

Integrated Management of Insects in Stored Products by B Subramanyam and D W Hagstrum

Introduction of Insect Pest management by George S S Ignacimuthu and S.Jayaraj

Course title: Manures, Fertilizers and Soil Fertility Management

Course Code: 1280014339

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		3 (2+1)	32		16			3	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures. Green/leaf manuring. Fertilizer recommendation approaches. Integrated nutrient management.

Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order.

History of soil fertility and plant nutrition. criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions.

Practical

Introduction of analytical instruments and their principles, calibration and applications, Colorimetry and flame photometry. Estimation of soil organic carbon, Estimation of alkaline hydrolysable N in soils. Estimation of soil extractable P in soils. Estimation of exchangeable K; Ca and Mg in soils. Estimation of soil extractable S in soils. Estimation of DTPA extractable Zn in soils. Estimation of N in plants. Estimation of P in plants. Estimation of K in plants. Estimation of S in plants.

A. THEORY

Learning objectives:

1. To know about different manures, fertilizers
2. To manage the soil quality
3. To improve soil health
4. The relationship between soil fertility and plant health
5. To achieve the goals of a sustainable fertility/soil management program

Prerequisite: Classroom, field, chemical laboratory.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures. Green/leaf manuring.	5	16
Module-II: Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order.	8	25
Module-III: History of soil fertility and plant nutrition. criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants.	6	18
Module-IV: Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants.	8	25
Module- V: Fertilizer recommendation approaches. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions. Integrated nutrient management.	5	16

Course learning outcome:

CO1: The students get knowledge about different nutrients essential for plant growth, kind of manures, fertilizers.

CO2: The students will learn how to maintain the soil health without compromising yield.

CO3: Understand the concept of soil fertility and productivity and how it can be enhanced.

Pedagogy for Course Delivery: PowerPoint presentation, using whiteboard and marker, video presentation.

List of Professional Skill Development Activities (PSDA)

1. Soil Mapping for nutrient analysis.
2. Fertilizer recommendation using different approaches (DRIS, STCR and others).
3. Vermicompost preparation.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To acquire practical knowledge on nutrient analysis of soil and plant.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Introduction of analytical instruments and their principles, calibration and applications.

Practical-2: Estimation of soil organic carbon.

Practical-3: Studies on different compost preparation methods.

Practical-4: Estimation of alkaline hydrolysable N in soils.

Practical-5: Estimation of soil extractable P in soil.

Practical-6: Estimation of exchangeable K in soil.

Practical-7: Estimation of exchangeable Ca in soil.

Practical-8: Estimation of exchangeable Mg in soil.

Practical-9: Estimation of soil extractable S in soils.

Practical-10: Estimation of DTPA extractable Zn in soils.

Practical-11: Estimation of N in plants.

Practical-12: Estimation of P in plants.

Practical-13: Estimation of K in plants.

Practical-14: Estimation of S in plants.

Practical-15: Estimation of Zn in plants.

Practical-16: Identification of commonly used manures and fertilizers.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

Textbook of Plant Nutrient Management by Prasad, R, Kumar, D, Rana, D.S., Shivay, Y.S. and Tewatia, R.K.

Manures and Fertilizers by A.K. Kolay, Atlantic Publishers & Dist.

Additional reading: Soil Fertility and Nutrient Management by S.S. Singh

Course title: Pests of Crops and Stored Grains and their Management

Course Code: 1280014340

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		3 (2+1)	2		1			0	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

General account on nature and type of damage by different arthropods pests. Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crop, vegetable crop, fruit crop, plantation crops, ornamental crops, spices and condiments. Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain. Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Storage structure and methods of grain storage and fundamental principles of grain store management.

Practical

Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking crops and their produce: (a) Field Crops; (b) Vegetable Crops; (c) Fruit Crops; (d) Plantation, gardens, Narcotics, spices & condiments. Identification of insect pests and Mites associated with stored grain. Determination of insect infestation by different methods. Assessment of losses due to insects. Calculations on the doses of insecticides application technique. Fumigation of grain store / godown. Identification of rodents and rodent control operations in godowns. Identification of birds and bird control operations in godowns. Determination of moisture content of grain. Methods of grain sampling under storage condition. Visit to Indian Storage Management and Research Institute, Hapur and Quality Laboratory, Department of Food., Delhi. Visit to nearest FCI godowns.

A. THEORY

Learning objectives:

- To introduce the basic idea of economic entomology.*
- To address the insect pest problems of farmers both under field and storage conditions so that immediate steps can be taken up to keep the pest population under check and to avoid significant crop damage.*
- To analyze the role of factors affecting stored grain losses.*
- To understand the basic concept of insect pests and non-insect pests of stored grain.*
- To evaluate the principles of stored grain management.*

Prerequisite: Software, computer, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: General account on nature and type of damage by different arthropods pests.	4	13
Module-II: Scientific name, order, family, host range, distribution, biology and	10	31

bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crop, vegetable crop, fruit crop, plantation crops, ornamental crops, spices and condiments.		
Module-III: Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain.	9	28
Module-IV: Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Storage structure and methods of grain storage and fundamental principles of grain store management.	9	28

- **Course learning outcome:**

CO1: To acquire a scientific knowledge for students about the insect pests of crops and their management.

CO2: To identify the storage insect pest, diagnose the symptom and advocate the necessary remedial measures.

CO3: To impart knowledge on non-insect pests of crops and their suitable management strategies.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board.

PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To know the basic knowledge about the identification of pest crops.
2. To apply pest management tactics for managing insect pests.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Identification of different types of damage.

Practical-2: Identification and study of life cycle and seasonal history of various insect pests attacking Field Crops and their produce: (a)

Practical-3: Identification and study of life cycle and seasonal history of various insect pests attacking vegetable crops

Practical-4: Identification and study of life cycle and seasonal history of various insect pests attacking fruit crops

Practical-5: Identification and study of life cycle and seasonal history of various insect pests attacking plantation crops and gardens

Practical-6: Identification and study of life cycle and seasonal history of various insect pests attacking narcotics

Practical-7: Identification and study of life cycle and seasonal history of various insect pests attacking spices and condiments

Practical-8: Identification of insect pests and Mites associated with stored grain.

Practical-9: Determination of insect infestation by different methods. Assessment of losses due to insects.

Practical-10: Calculations on the doses of insecticides application technique.

Practical-11: Fumigation of grain store / godown.

Practical-12: Identification of rodents and rodent control operations in godowns.

Practical-13: Identification of birds and bird control operations in godowns.

Practical-14: Determination of moisture content of grain.

Practical-15: Methods of grain sampling under storage condition.

Practical-16: Visit to Indian Storage Management and Research Institute, Hapur and Quality Laboratory, Department of Food., Delhi. Visit to nearest FCI godowns.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. Atwal, A.S. 1976. *Agricultural Pests of India and South East Asia*. Kalyani Publishers, Ludhiana.
2. Butani, D.K. and Jotwani, M.G. 1984. *Insects in Vegetables*. Periodical Export Book Agency, New Delhi.
3. Butani, D. K. 1984. *Insects and Fruits*. Periodical Export Book Agency, New Delhi.
4. Dennis S Hill 1987 *Agricultural Insect Pests of tropics and their control*, Cambridge Universtiy Press , New York
5. Khare, S.P. 1993. *Stored Grain Pests and Their Management*. Kalyani Publishers, Ludhiana
6. Kumar, R., (2017). *Insect Pests of Stored Grains*. Tylor and Francis Groups, Florida USA. 978-1-77188.
7. David, B. B and Ramamurthy, V. V., (2016). *Elements of Economic Entomology*. Brillion Publishing House, New Delhi. 9780994869104.

Course title: Fundamentals of Plant Pathology

Type	Code	Credit	Credit division					Total no of lecture
			L	T	P	SW	FW	
Compulsory		3 (2+1)	2		1			48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:**Theory**

Symptoms, etiology, disease cycle and management of major diseases of following crops:

Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro; Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra :downy mildew, smut and ergot; Groundnut: early and late leaf spots, collar rot, stem and pod rot, bud necrosis, Afla rot; Sesamum: Phyllody, stem rot and leaf spot; Soybean: Rhizoctonia blight and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; Black & green gram: Cercospora leaf spot and anthracnose, powdery mildew and yellow mosaic; Castor: Wilt and root rot; Tobacco: Damping off, black shank, frog eye, leaf curl and mosaic.

Horticultural Crops: Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top; Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight and leaf spot; Brinjal: Phomopsis blight and fruit rot and little leaf; Tomato: early and late blight, buck eye rot and leaf curl and tomato spotted wilt; Okra: Yellow Vein Mosaic and root knot nematode; Beans: anthracnose and bacterial blight; Colocasia: Phytophthora blight; Coconut: wilt, stem bleeding and bud rot; Tea: blister blight; Coffee: rust; Cluster bean: powdery mildew, bacterial blight and bean common mosaic.

Practical

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for Herbarium; Note: Students should submit 50 pressed and well-mounted specimens.

A.THEORY

Learning objectives:

Main objective of this subject is to acquaint student about the diseases of field and horticultural crops and their management

Prerequisite: Classroom, well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Symptoms, etiology, disease cycle and management of major diseases of following crops: Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro.	2	6
Module-II: Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra: downy mildew and ergot; Groundnut: early and late leaf spots, wilt; Soybean: Rhizoctonia blight, bacterial spot,	11	33

seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic.		
Module-III: Castor: Wilt and root rot; Tobacco: Damping off, black shank, frog eye, leaf curl and mosaic. Horticultural Crops: Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top; Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight and leaf spot; Cruciferous vegetables: Alternaria leaf spot and black rot; Brinjal: Phomopsis blight, fruit rot and little leaf.	10	31
Module-IV: Tomato: early and late blight, buck eye rot and leaf curl and tomato spotted wilt; Okra: Yellow Vein Mosaic and root knot nematode; Beans: anthracnose and bacterial blight; Colocasia: Phytophthora blight; Coconut: wilt, stem bleeding and bud rot; Tea: blister blight; Coffee: rust; Cluster bean: powdery mildew, bacterial blight and bean common mosaic.	09	30

Course learning outcome:

CO1: Students will understand the importance of studying the disease cycles.

CO2: To gather knowledge about the different types of symptoms during infection by various types of pathogens.

CO3: To understand the role of weather and disease forecasting before the spread of epidemics.

CO4: To impart knowledge about prevention and control measures during the disease spread, disease cycle and integrated pest management of horticultural & field crops.

Pedagogy for Course Delivery:

List of Professional Skill Development Activities (PSDA)

Major part of the course shall be delivered using Markers on White board.

PPT's may be used for showing various types of disease symptoms as well as for review of prerequisite topics/revision of current topics.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

- 1. Main objective of this subject is to familiarize the students about the crops and plant disease due to pests*
- 2. It also helps the students to develop the knowledge about how to preserve the disease samples.*

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory

Practical-2: Field visit for the diagnosis of field problems.

Practical-3: Collection and preservation of plant diseased specimens for Herbarium; ; Note: Students should submit 50 pressed and well-mounted specimens.

Continuous assessment: Quiz/assessment/identification/Herbarium etc.

Text & Reference books:

- *Crop diseases and their management by Y S Ahlawat and S Nagarajan*
- *Diseases of Field Crops and Their Management by T.S.Thind*
- *Plant disease by R.S. Singh*
- *Diseases of vegetable crops by R.S. Singh*
- *Diseases of fruit crops by R.S. Singh*

Course title: Crop Improvement – I (Kharif)

Course Code: 1140014342

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2(1+1)	16		16			4	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:**Theory:**

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeonpea, etc. Ideotype concept and climate resilient crop varieties for future.

Practical:

Floral biology, emasculation and hybridization techniques in different crop species; viz., Rice, Jute, Maize, Sorghum, Pearl millet, Ragi, Pigeonpea, Urdbean, Mungbean, Soybean, Groundnut, Sesame, Caster, Cotton, Cowpea, Tobacco, Brinjal, Okra and Cucurbitaceous crops. Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seeds production in Kharif crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops.

A. THEORY*Learning objectives:*

1. This course is designed such a way that students will understand the origin, distribution and different breeding methods to be adopted for the development of varieties / hybrids in various kharif crops.
2. Students will know about plant genetic resources, centres of diversity in detail. In this course breeding for resistance to biotic and abiotic stresses is elaborately discussed.
3. Students will learn about learn about the influence of Genotype x Environment interaction on yield / performance.

Prerequisite: Well-equipped laboratory, white board and marker, classroom with projector.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Study in respect of origin, distribution of species, wild relatives and major breeding procedures of rice, maize, sorghum, pearl millet, finger millet, redgram, soybean, greengram, blackgram, ground nut, sesame, castor and cotton.	4	25

Module-II: Plant Genetic Resources: definition, important features of germplasm, kinds of germplasm, classification of gene pool, types of seed collections, germplasm activities, exploration – merits and demerits of exploration and collection of germplasm, germplasm conservation – in situ conservation, ex-situ conservation, evaluation, documentation, distribution and utilization.	3	19
Module-III: Important concepts of breeding self-pollinated, cross- pollinated and vegetatively propagated crops. Breeding for biotic, abiotic stress and study of Qualitative and Quantitative characters	4	25
Module-IV: Seed production technology in self pollinated, cross pollinated and vegetatively propagated crops. Ideotype concept, main features of ideotype breeding, features of ideotypes of wheat, rice, maize, barley and cotton. Genotype, environment and their interaction; Adaptability & stability, types of adaptation- adaptability; Stability: models for stability analysis. Ideotype concept and climate resilient crop varieties for future.	5	31

Course learning outcome:

CO1: Understand the origin, distribution and different breeding methods to be adopted for the development of varieties / hybrids in various field and horticultural crops

CO2: Know about the plant genetic resources, centres of diversity and breeding for resistance to biotic and abiotic stresses

CO3: Learn about the influence of Genotype x Environment interaction on yield / performance

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

1. Idea about emasculation and crossing techniques, hybrid seed development in kharif crops
2. Maintenance of segregating generation
3. Idea about synthetic, composite varieties and different types of recurrent selection
4. Use of PCR, gel electrophoresis and different molecular markers.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To enrich students about floral biology and emasculation techniques about different kharif crops.
2. To make students aware about estimation of heterosis, inbreeding depression, heritability

3. To make students aware about seed production plots and AICRP plots and breeding designs.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

- Practical-1: Emasculation and hybridization techniques
 Practical-2: Maintenance breeding & study of field techniques for different kharif crops
 Practical-3: Handling of segregating generations: pedigree method, SSD, bulk method
 Practical-4: Estimation of heterosis, inbreeding depression, heritability
 Practical-5: Emasculation and hybridization methods in Rice
 Practical-6: Emasculation and hybridization methods in Maize
 Practical-7: Emasculation and hybridization methods in Sorghum
 Practical-8: Emasculation and hybridization methods in Pearl millet
 Practical-9: Emasculation and hybridization methods in Ragi, brinjal
 Practical-10: Emasculation and hybridization methods in Redgram, black gram, green gram
 Practical-11: Emasculation and hybridization methods in Soyabean, Groundnut, cowpea
 Practical-12: Emasculation and hybridization methods in castor, cotton
 Practical-13: Emasculation and hybridization methods in Sesame, tobacco
 Practical-14: Layout of field experiments, Study of quality characters, donor parents for different characters
 Practical-15: Visit to seed production plots
 Practical-16: Visit to AICRP plots of different field crops

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Crop Breeding and Biotechnology by HariHar Ram, KalyaniPublication New Delhi.
2. Principle and Procedures of Plant Breeding Biotechnological and Conventional Approach by G. S. Chahal and S. S. Gosla, Narosa Publishers House. New Delhi.
3. Breeding of Asian Field crops by D. A. Sleper J.M. Poehlman, Blackwell Publishers

Course title: Entrepreneurship Development and Business Communication

Course Code: 1140014343

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		1+1	16		16			6	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3hrs

Component:

Theory

Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs, SWOT Analysis & achievement motivation, Government policy and programs and institutions for entrepreneurship development, Impact of economic reforms on Agribusiness/ Agri enterprises, Entrepreneurial Development Process; Business Leadership Skills; Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation), Developing Managerial skills, Business Leadership Skills (Communication,

direction and motivation Skills), Problem solving skill, Supply chain management and Total quality management, Project Planning Formulation and report preparation; Financing of enterprise, Opportunities for Agri entrepreneurship and rural enterprise.

Practical

Assessing entrepreneurial traits, problem solving skills, managerial skills and achievement motivation, exercise in creativity, time audit through planning, monitoring and supervision, identification and selection of business idea, preparation of business plan and proposal writing, visit to entrepreneurship development institute and entrepreneurs.

Learning objectives:

- To familiarize the students, understand with key concepts and processes in entrepreneurship and business development.
- To provide context to the processes in the form of differences between small and large firms, and the economic environment.
- To introduce key debates around entrepreneurship and small businesses.

Prerequisite: Classroom, Laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs, SWOT Analysis & achievement motivation, Government policy and programs and institutions for entrepreneurship development.	6	37
Module-II: Impact of economic reforms on Agribusiness/Agri enterprises, Entrepreneurial Development Process; Business Leadership Skills; Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation).	4	25
Module-III: Developing Managerial skills, Business Leadership Skills (Communication, direction and motivation Skills), Problem solving skill, Supply chain management and Total quality management.	4	25
Module-IV: Project Planning Formulation and report preparation; Financing of enterprise, Opportunities for Agri entrepreneurship.	2	13

Course learning outcome:

CO1: This course makes able to develop entrepreneurial competencies among students

CO2: From the course, students may learn about the principles to develop an Enterprise or any business unit.

CO3: Students will able to build the possibility of entrepreneurship development.

Pedagogy for Course Delivery: Power point presentation, Verbal presentation by use of White board and Marker

List of Professional Skill Development Activities (PSDA): Group discussion, Debate, Seminar, Conference, Preparation of advertisement, Project report preparation

Continuous assessment: Quiz, assessment, assignment etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

- To develop Problem solving ability

- *To develop Personality.*
- *To understand and development about the key concept of entrepreneurship and business.*
- *To Understand project writing and project formulation process.*

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of Practical

Practical 1: Assessment of Problem-solving ability

Practical 2: Study on problem solving method through shrinking vessel game.

Practical 3: Assessment of Problem-solving ability through Legoman Concept

Practical 4: Assessment of Problem-solving ability through Minefield game.

Practical 5: Oral presentation.

Practical 6: Group presentation.

Practical 7: Power point presentation.

Practical 8: Seminar and Conferences.

Practical 9: Conducting mock interview, testing team spirit and leadership.

Practical 10: Preparing advertisement for popularization of product and news writing.

Practical 11: Conduction of Group Discussion.

Practical 12: Conduction of Debate.

Practical 13: Conducting meeting- purposes, procedure, participation, physical arrangements, recording and writing of minutes of the meeting.

Practical 14: Telephonic conversation: Rate of speech, clarity of voice, speaking and listening, politeness and telephonic etiquettes.

Practical 15: Project proposal preparation

Practical 16: Visit to entrepreneurship institute/ case study of successful entrepreneurs.

Continuous assessment: Viva-Voce, Assessment etc.

Text & Reference books:

1. Khanka, S.s. 1999. Entrepreneurship Development. S.Chand and Co., New Delhi.
2. Sagar Mondal and Ray, G.L. 2003. Text Book of Entrepreneurship and Rural Development. Kalyani Publishers, Ludhiana.
3. Sagar Mondal. 2020. Entrepreneurship Development and Business Communication. Kalyani Publishers.

Course title: Geoinformatics, Nano-technology and Precision Farming

Course Code: 1140014344

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2 (1+1)	16		16			3	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:**Theory**

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions; Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; STCR approach for precision agriculture; Nanotechnology, definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity.

Practical

Introduction to GIS software, spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. Generation of spectral profiles of different objects. Supervised and unsupervised classification and acreage estimation. Multispectral remote sensing for soil mapping. Creation of thematic layers of soil fertility based on GIS. Creation of productivity and management zones. Fertilizers recommendations based of VRT and STCR techniques. Crop stress (biotic/abiotic) monitoring using geospatial technology. Use of GPS for agricultural survey. Formulation, characterization and applications of nanoparticles in agriculture. Projects formulation and execution related to precision farming.

A. THEORY

Learning objectives:

- 1. To introduce the basic concepts of geoinformatics, precision farming and nanotechnology.*
- 2. To create awareness about various applications of geoinformatics and nanotechnology for precision agriculture*
- 3. To prepare soil map; fertilizer recommendation using geospatial technologies*
- 4. To use nanotechnology in tillage, seed, water, fertilizer, plant protection for scaling-up farm productivity.*

Prerequisite: Software, computer, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture. STCR approach for precision agriculture.	3	18

Module-II: Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions	7	45
Module-III: Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs	2	12
Module-IV: Nanotechnology, definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity.	4	25

Course learning outcome: On successful completion of this course students will be able to

CO1: Understand the concept of precision agriculture and nanotechnology.

CO2: Understand roles of nanotechnology in traditional as well as precision agriculture and other areas of agriculture.

CO3: Acquaint with recent developments image processing, GIS and RS software, spatial data creation and editing, Soil Mapping for EC, Organic Carbon, soil nutrient and others.

Pedagogy for Course Delivery:

List of Professional Skill Development Activities (PSDA)

1. Soil Mapping for EC, Organic Carbon, soil nutrient.
2. Fertilizer recommendation using geospatial technologies.
3. Introduction to GIS and RS software, spatial data creation and editing.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To apply geoinformatics and nanotechnology for precision agriculture.
2. To teach basic handling of various geoinformatic tools.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Introduction to GIS software, spatial data creation and editing.

Practical-2: Introduction to image processing software.

Practical-3: Visual and digital interpretation of remote sensing images.

Practical-4: Generation of spectral profiles of different objects.

- Practical-5: Supervised and unsupervised classification and acreage estimation.
 Practical-6: Multispectral remote sensing for soil mapping.
 Practical-7: Creation of thematic layers of soil fertility based on GIS.
 Practical-8: Creation of productivity and management zones.
 Practical-9: Fertilizers recommendations based of VRT technique.
 Practical-10: Fertilizers recommendations based of STCR technique.
 Practical-11: Crop stress (biotic/abiotic) monitoring using geospatial technology.
 Practical-12: Use of GPS for agricultural survey.
 Practical-13: Formulation, characterization and applications of nanoparticles in agriculture.
 Practical-14: Projects formulation and execution related to precision farming.
 Practical-15: Preparation of Interpolation map of Organic Carbon by IDW method.
 Practical-16: Soil fertility map using GIS.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

Geoinformatics and NanoTechnology for Precision Farming by SR Reddy

Textbook on Geo-informatics, Nanotechnology and Precision Farming by Tarun Kumar Upadhyay and Sushil Kumar Sharma

Additional reading: *Geo-Informatics by A.M. Chandra*

Course title: Practical Crop Production Technology-I (Kharif Crops)

Course Code: 1280012318

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2 (0+2)			32			2	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
32	2

Component:

Practical

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

Learning objectives:

To teach the practical growing of crop husbandry of different kharif crop.

Prerequisite: Land, lab, classroom.

Course learning outcome: This course offers a wide scope for students in skill development regarding kharif crop production, management and post-harvest handling.

CO1: Students will be able to prepare field, nursery management, sowing, nutrient management, water and weed management.

CO2: Students will be able to manage disease and insect, harvest, store and sell the product.

CO3: Students will be able to prepare balance sheet.

Pedagogy for Course Delivery: Power point presentation, Verbal presentation by Using white board and marker

List of Professional Skill Development Activities (PSDA)

1. Demonstrate an ability to work effectively with others.
2. Recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable decisions.
3. A fundamental understanding of economic principles and their application to agricultural, resource, rural and related issues.
4. Knowledge dissemination regarding various technique of farming and farming system, types of market and marketing of agricultural produce.
5. Acquire the ability to engage in independent and life-long learning in the ever-changing agricultural production system/enterprises.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

To teach the practical growing of crop husbandry of different kharif crop.

Total no. of practical	Total contact hour	Contact hour/week
32	64	2

List of practical

- Practical-1: Crop planning and raising field crops in multiple cropping systems.
- Practical-2: Field layout preparation, seed treatment, nursery raising and sowing.
- Practical-3: Nutrient management.
- Practical-4: Water management.
- Practical-5: Weed management.
- Practical-6: Management of insect-pests diseases of crops.
- Practical-7: Harvesting.
- Practical-8: Threshing, drying , winnowing & storage.
- Practical-9: Marketing of produce.
- Practical-10: Seed production.
- Practical-11: Mechanization.
- Practical-12: Resource conservation management.
- Practical-13: Integrated nutrient management.
- Practical-14: Insect-pest management technologies.
- Practical-15: Disease management technologies.
- Practical-16: Preparation of Balance Sheet Including Cost of Cultivation, Net Returns Per Student as well as Per Team of a Group of Students.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. *Irrigation Water Management- Dilip Kumar Majumdar*
2. *Soil Fertility and Fertilizers- Tisdale and Nelson*
3. *Field Crop Production- Rajendra Prasad*

Course title: Intellectual Property Rights

Course Code: 1280015156

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		1 (1+0)	16	0	16	0	0	2	16

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
16	1

Component:

Theory

Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPs and WIPO, Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc. Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets. Patents Act 1970 and Patent system in India, patentability, process and product patent, filing of patent, patent specification, patent claims, Patent opposition and revocation, infringement, compulsory licensing, Patent Cooperation Treaty, Patent search and patent database. Origin and history including a brief introduction to UPOV for protection of plant varieties, Protection of plant varieties under UPOV and PPV&FR Act of India, Plant breeders rights, Registration of plant varieties under PPV&FR Act 2001, breeders, researcher and farmers rights. Traditional knowledge-meaning and rights of TK holders. Convention on Biological Diversity, International treaty on plant genetic resources for food and agriculture (ITPGRFA). Indian Biological Diversity Act, 2002 and its salient features, access and benefit sharing.

A. THEORY

Learning objectives:

5. *To familiarize the students about the technical difficulties in world trades and intellectual property rights followed all over the world.*

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPs and WIPO, Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.	3	18
Module-II: Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits,	7	45

Trade secrets. Patents Act 1970 and Patent system in India, patentability, process and product patent, filing of patent, patent specification, patent claims, Patent opposition and revocation, infringement, Compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.		
Module-III: Origin and history including a brief introduction to UPOV for protection of plant varieties, Protection of plant varieties under UPOV and PPV&FR Act of India, Plant breeders rights, Registration of plant varieties under PPV&FR Act 2001, breeders, researcher and farmers rights.	2	12
Module-IV: Traditional knowledge-meaning and rights of TK holders. Convention on Biological Diversity, International treaty on plant genetic resources for food and agriculture (ITPGRFA). Indian Biological Diversity Act, 2002 and its salient features, access and benefit sharing.	4	25

Course learning outcome:

CO1: To apply the skills in intellectual property, GATT, WTO, TRIPs and WIPO, Treaties for IPR protection.

CO2: To evaluate UPOV for protection of plant varieties, Protection of plant varieties under UPOV and PPV&FR Act of India

CO3: To analyse traditional knowledge-meaning and rights of TK holders.

CO4: To understand technical difficulties in world trades and intellectual property rights followed all over the world.

Pedagogy for Course Delivery: PowerPoint presentation and verbal presentation by using White board and marker.

List of Professional Skill Development Activities (PSDA)

1. To impart UPOV for protection of plant varieties, Protection of plant varieties under UPOV and PPV&FR Act of India.
2. Students will learn about traditional knowledge-meaning and rights of TK holders.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

Text & Reference books:

1. Law Relating to Intellectual Property Rights by V K Ahuja, Agribios (India), Jain Book Agency.
2. Intellectual Property Rights by Neeraj Pandey and Khushdeep Dharni, UBS.

Sample CO-PO Matrix

Semester VI

Course title: Rainfed Agriculture and Watershed Management

Course Code: 1280015349

Type	Code	Credit	Credit division					Total no of lecture
			L	T	P	SW	FW	
Compulsory		2 (1+1)	16		16			32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India; Problems and prospects of rainfed agriculture in India ; Soil and climatic conditions prevalent in rainfed areas; Soil and water conservation techniques, Drought: types, effect of water deficit on physio-morphological characteristics of the plants, Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices, Management of crops in rainfed areas, Contingent crop planning for aberrant weather conditions, Concept, objective, principles and components of watershed management, factors affecting watershed management.

Practical

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country, effective rainfall and its calculation. Studies on cultural practices for mitigating moisture stress. Characterization and delineation of model watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

A. THEORY

Learning objectives:

1. To familiarize the students on an advanced level with the application of traditional and modern techniques to water management problems, such as erosion control, drainage, irrigation, flood control, moisture conservation, water resource development, etc.
2. Students learn basic knowledge of rain fed agriculture and water shed management.
3. Study the crop adaptation and mitigation strategies under stress.
4. Main objective is to increase / stabilize production of crops, forage, fruits, fuel and timber in rainfed areas by introduction of improved soil and moisture conservation measures, better crop and range land management practices.

Prerequisite: Field, Classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Rainfed agriculture: Introduction, types, History of rainfed agriculture and	4	25

watershed in India; Problems and prospects of rainfed agriculture in India; Soil and climatic conditions prevalent in rainfed areas		
Module-II: Soil and water conservation techniques, Efficient utilization of water through soil and crop management practices, Management of crops in rainfed areas, Contingent crop planning for aberrant weather conditions	5	30
Module-III: Drought: types, effect of water deficit on physio-morphological characteristics of the plants, Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques, Concept, objective, principles and components of watershed management, factors affecting watershed management	7	45

Course learning outcome:

CO1: Students will be able to identify the soil and climatic conditions prevalent in rainfed areas.

CO2: Students will be able to understand various water harvesting: importance, its technique, efficient utilization.

CO3: Students will be able to understand the contingent crop planning for aberrant weather condition.

Pedagogy for Course Delivery: PowerPoint presentation, white board and marker use.

List of Professional Skill Development Activities (PSDA)

1. Crop planning and crop management.
2. Soil and moisture conservation.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To study cultural practices for mitigating moisture stress.
2. Characterization and delineation of model watershed.
3. Field demonstration on soil, moisture conservation measures and water harvesting structures.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Studies on climate classification.

Practical-2: Studies on cropping pattern of different dry land areas in the country.

Practical-3: Interpretation of meteorological data regarding evapo-transpiration demand of crops.

Practical-4: Critical analysis of rainfall and possible drought period in the country.

Practical-5: Studies on cultural practices viz; mulching for mitigating moisture stress.
Practical-6: Characterization and delineation of model watershed.
Practical-7: Field demonstration on soil & moisture conservation measures.
Practical-8: Field demonstration on construction of water harvesting structures.
Practical-9: Visit to rainfed research station/watershed.
Practical-10: Critical analysis of effective rainfall and its calculation.
Practical-11: Demarcation of dry land area on map of India.
Practical-12: Studies on rainfall pattern in rainfed areas of the country.
Practical-13: Studies on pattern of onset and withdrawal of monsoons.
Practical-14: Scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops.
Practical-15: Studies on cultural practices viz plant density and depth of sowing for mitigating moisture stress.
Practical-16: Studies on cultural practices viz thinning and leaf removal for mitigating moisture stress.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

Rainfed Agriculture & Watershed Management by SR Reddy and G Prabhakara Reddy

Textbook of Rainfed Agriculture and Watershed Management by P.L. Maliwal

Additional reading: Rainfed Agriculture and Watershed Management by Dr. Rayees Ahmad Shah

Course title: Protected Cultivation and Secondary Agriculture

Course Code: 1280015358

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2(1+1)	16		16			3	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:**Theory:**

Green house technology: Introduction, Types of Green Houses; Plant response to Greenhouse environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes. Green house equipments, materials of construction for traditional and low-cost green houses. Irrigation systems used in greenhouses, typical applications, passive solar green house, hot air greenhouse heating systems, green house drying. Cost estimation and economic analysis.

Important Engineering properties such as physical, thermal and aero & hydrodynamic properties of cereals, pulses and oilseed, their application in PHT equipment design and operation. Drying and dehydration; moisture measurement, EMC, drying theory, various drying method, commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer and solar dryer). Material handling equipment; conveyer and elevators, their principle, working and selection.

Practical:

Study of different type of greenhouses based on shape. Determine the rate of air exchange in an active summer winter cooling system. Determination of drying rate of agricultural products inside green house. Study of greenhouse equipments. Visit to various Post Harvest Laboratories. Determination of Moisture content of various grains by oven drying & infrared moisture methods. Determination of engineering properties (shape and size, bulk density and porosity of biomaterials). Determination of Moisture content of various grains by moisture meter. Field visit to seed processing plant.

A. THEORY

Learning objectives:

- 1. Development of better understanding regarding recent advances in crop management under protected cultivation.*
- 2. Obtaining sufficiency in fruits, vegetables and flowers under protected cultivation in on and off season.*
- 3. Better designing of infrastructure for protected cultivation in different agro-climatic conditions.*
- 4. Enhancement of total crop duration of horticultural crops than traditional ones.*
- 5. Developing low-cost indigenous protected cultivation technologies for enhancing productivity in horticultural crops.*

Prerequisite: Well-equipped laboratory, white board and marker, classroom with projector.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Greenhouse technology: Introduction, Types of Green Houses; Plant response to Greenhouse environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes. Green house equipments, materials of construction for traditional and low cost green houses.	6	37.50
Module-II: Irrigation systems used in greenhouses, typical applications, passive solar green house, hot air green house heating systems, green house drying. Cost estimation and economic analysis.	2	12.50
Module-III: Important Engineering properties such as physical, thermal and aero & hydrodynamic properties of cereals, pulses and oilseed, their application in PHT equipment design and operation.	3	18.75
Module-IV: Drying and dehydration; moisture measurement, EMC, drying theory, various drying method, commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer and solar dryer).	2	12.50
Module-V: Material handling equipment; conveyer and elevators, their principle, working and selection.	3	18.75

Course learning outcome:

CO1: Understand greenhouse technology, types of green houses and construction of green houses

CO2: Identify greenhouse equipment, materials of construction for traditional and low cost green houses.

CO3: Demonstrate use of irrigation systems in greenhouses, shade net house in protected cultivation.

CO4: Explain the concepts of cleaning and grading moisture measurement

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

- 1. Design and development of greenhouse technology.*
- 2. Important Engineering properties and their application in PHT equipment design and operation.*
- 3. Knowledge about drying and material handling equipment.*

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. Understand the basic concepts of greenhouse and its application.
2. Determination of engineering properties and its use in PHE.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

- Practical-1 Study of different type of greenhouses based on shape.
- Practical-2 Determine the rate of air exchange in an active summer winter cooling system.
- Practical-3 Determination of drying rate of agricultural products inside green house.
- Practical-4 Study of greenhouse equipments.
- Practical-5 Visit to various Post Harvest Laboratories.
- Practical-6 Determination of Moisture content of various grains by oven drying method.
- Practical-7 Determination of Moisture content of various grains by infrared moisture methods.
- Practical-8 Determination of engineering properties (shape and size of biomaterials)
- Practical-9 Determination of engineering properties (bulk density of biomaterials).
- Practical-10 Determination of engineering properties (porosity of biomaterials).
- Practical-11 Determination of Moisture content of various grains by moisture meter.
- Practical-12 Field visit to seed processing plant.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Reddy S, Janakiram B, Balaji T, Kulkarni S & Misra RL. 2007. Hightech Floriculture. Indian Society of Ornamental Horticulture, New Delhi.
2. Aldrich RA & Bartok JW. 1994. Green House Engineering. NRAES, Riley, Robb Hall, Cornell University, Ithaca, New York.

Course title: Diseases of Field and Horticultural Crops and their Management II

Course Code: 1280013337

Type	Code	Credit	Credit division					Total no of lecture
			L	T	P	SW	FW	
Compulsory		3 (2+1)	2		1			48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

Symptoms, etiology, disease cycle and management of following diseases:

Field Crops: Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight, and ear cockle; Sugarcane: red rot, smut, wilt, grassy shoot and ratoon stunting; Sunflower: Sclerotinia stem rot and Alternaria blight; Mustard: Alternaria blight, white rust, downy mildew, powdery mildew and Sclerotinia stem rot; Gram: wilt, root rot and Ascochyta blight; Lentil: rust and wilt; Cotton: anthracnose, vascular wilt, and black arm; Pea: downy mildew, powdery mildew and rust.

Horticultural Crops: Mango: anthracnose, malformation, powdery mildew and red rust; Citrus: canker and gummosis; Grape vine: downy mildew, Powdery mildew and anthracnose; Guava: wilt and anthracnose; Ber: powdery mildew; Apple: scab, powdery mildew, fire blight; Peach: leaf curl; Strawberry: leaf spot; Sapota: leaf spot; Potato: early and late blight, black scurf, bacterial brown rot, scab, leaf roll, and mosaic; Cucurbits: downy mildew, powdery mildew, wilt; Onion and garlic: purple blotch, and Stemphylium blight; Chillies: anthracnose and fruit rot, wilt and leaf curl; Ginger: soft rot; Turmeric: leaf spots; Fenugreek: powdery mildew; Cumin: Alternaria blight, powdery mildew and wilt; Fennel: Ramularia blight, stem rot; Coriander: stem gall and powdery mildew; Cruciferous vegetables: Alternaria leaf spot and black rot; Marigold: blight; Rose: dieback, powdery mildew and black leaf spot.

Practical

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for herbarium.

A.THEORY

Learning objectives:

Main objective of this subject is to familiarize the students about the diseases in fields and horticulture

Prerequisite: Classroom, well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Symptoms, etiology, disease cycle and management of following diseases: Field Crops: Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight, and ear cockle; Sugarcane: red rot, smut, wilt, grassy shoot and ratoon stunting.	4	13
Module-II: Sunflower: Sclerotinia stem rot and Alternaria blight; Mustard: Alternaria blight, white rust, downy mildew, powdery mildew and Sclerotinia stem rot; Gram: wilt, root rot and Ascochyta blight; Lentil: rust and wilt; Cotton: anthracnose, vascular wilt, and black arm; Pea: downy mildew, powdery mildew and rust.	7	21
Module-III: Horticultural Crops: Mango: anthracnose, malformation, powdery mildew and red rust; Citrus: canker and gummosis; Grape vine: downy mildew, Powdery mildew and anthracnose; Guava: wilt and anthracnose; Ber: powdery mildew; Apple: scab, powdery mildew and fire blight; Peach: leaf curl. Strawberry: leaf spot; Sapota: leaf spot.	10	32
Module-IV: Potato: early and late blight, black scurf, bacterial brown rot, scab, leaf roll, and mosaic; Cucurbits: downy mildew, powdery mildew, wilt; Onion and garlic: purple blotch, and Stemphylium blight; Chillies: anthracnose and fruit rot, wilt and leaf curl; Ginger: soft rot; Turmeric: leaf spots; Fenugreek: powdery mildew; Cumin: Alternaria blight, powdery mildew and wilt; Fennel: Ramularia blight, stem	11	34

rot; Coriander: stem gall and powdery mildew; Cruciferous vegetables: Alternaria leaf spot and black rot; Marigold: blight; Rose: dieback, powdery mildew and black leaf spot.		
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Course learning outcome:

CO1: Students will understand the importance of studying the disease cycles.

CO2: To gather knowledge about the different types of symptoms during infection by various types of pathogens.

CO3: To understand the role of weather and disease forecasting before the spread of epidemics.

CO4: To impart knowledge about prevention and control measures during the disease spread, disease cycle and integrated pest management of horticultural & field crops.

Pedagogy for Course Delivery:

List of Professional Skill Development Activities (PSDA)

Major part of the course shall be delivered using Markers on White board.

PPT's may be used for showing various types of disease symptoms as well as for review of prerequisite topics/revision of current topics.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL(total contact hours, hr/week), if applicable

Learning objectives:

1. Main objective of this subject is to familiarize the students about the crops and plant disease due to pests
2. It also helps the students to develop the knowledge about how to preserve the disease samples.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory

Practical-2: Field visit for the diagnosis of field problems.

Practical-3: Collection and preservation of plant diseased specimens for Herbarium; ; Note: Students should submit 50 pressed and well-mounted specimens.

Continuous assessment: Quiz/assessment/identification/Harberium etc.

Text &Reference books:

- Crop diseases and their management by Y S Ahlawat and S Nagarajan
- Diseases of Field Crops and Their Management by T.S.Thind
- Plant disease by R.S. Singh
- Diseases of vegetable crops by R.S. Singh
- Diseases of fruit crops by R.S. Singh

Course title: Post-harvest Management and Value Addition of Fruits and Vegetables.

Course Code: 1280015351

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2 (1+1)	16		16			2	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Importance of fruits and vegetables, extent and possible causes of post harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Role of ethylene; Post harvest disease and disorders; Heat, chilling and freezing injury; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric); Value addition concept; Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and non-fermented beverages. Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying. Canning -- Concepts and Standards, packaging of products.

Practical

Applications of different types of packaging containers for shelf life extension.Effect of temperature on shelf life and quality of produce.Demonstration of chilling and freezing injury in vegetables and fruits.Extraction and preservation of pulps and juices. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy and tomato products, canned products. Quality evaluation of products -- physico-chemical and sensory. Visit to processing unit/ industry.

A. THEORY

Learning objectives:

1. To identify and provide inputs to mitigate postharvest losses during cool chain management.
2. To provide skill on postharvest loss reduction through processing of fruits and vegetables.
3. To facilitate the students with knowledge and activities of food processing industries and also drive towards entrepreneurship.

Prerequisite: Lab, Classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Importance of post-harvest processing of fruits and vegetables, extent and possible causes of post-harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening;	5	32

Module-II: Respiration and factors affecting respiration rate; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric); Value addition concept; Principles and methods of preservation	5	32
Module-III: Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and non-fermented beverages. Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying. Canning – Concepts and Standards, packaging of products.	6	36

Course learning outcome:

CO1: Students will able to understand the importance and use of processing and value addition of fruits and vegetables.

CO2: Students will able to understand the physiology and principle of fruit and vegetable preservation.

CO3: Students will able to understand Fundamentals of preservation (principles and practices). Micro-organism associated with spoilage of fruits and vegetables. Source of micro-organism, conditions, infection and control.

CO4: Students will able to apply Various methods of preservation like low temperature preservation, refrigeration, cellar storage, freezing, vacuum freezing, high temperature preservation in different postharvest industry.

Pedagogy for Course Delivery: verbal presentation with power point.

List of Professional Skill Development Activities (PSDA)

1. To provide skill on postharvest loss reduction through processing of fruits and vegetables.
2. To facilitate the students with knowledge and activities of food processing industries and also drive towards entrepreneurship.

Continuous assessment: Quiz, assessment, assignment etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

- To input the skill on different types of food processing technique of fruits and vegetables.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Applications of different types of packaging containers for shelf life extension.

Practical-2: Effect of temperature on shelf life and quality of produce.

Practical-3: Demonstration of chilling and freezing injury in vegetables and fruits.

Practical-4: Extraction and preservation of pulps and juices.

Practical-5: Preparation of jam.

Practical-6: Preparation of jelly.

Practical-7: Preparation of RTS.

Practical-8: Preparation of nectar.

Practical-9: Preparation of squash.

Practical-10: Preparation of osmotically dried products.

Practical-11: Preparation of fruit bar and candy.

Practical-12: Preparation of tomato sauce.

Practical-13: Preparation of tomato ketchup.

Practical-14: Preparation of canned products.

Practical-15: Quality evaluation of products - (physic-chemical and sensory).

Practical-16: Visit to processing unit/ industry.

Continuous assessment: Viva-voce/assessment etc.

Text & Reference books:

1. Rathore, N.S., Mathur, G.K., Chasta, S.s. 2012. Post-harvest Management and Processing of Fruits and Vegetables. ICAR, New Delhi
2. Srivastava, R.P. and Sanjeev Kumar, 2002. Fruit and vegetable Preservation: Principles and Practices. International Book Distributio Company, Lucknow.
3. Giridharilal, G.S., Siddappa and Tondon, G.L. 2007. Preservation of Fruits and Vegetables. ICAR, New Delhi.
4. Mitra, S.K. 2005, Post Har4vest Physiology and Storage of Tropical and Subtropical Fruits. CABI Publishers, Kolkatta.

Course title: Management of Beneficial Insects

Course Code: 1280015352

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2 (1+1)	1		1			3	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:**Theory**

Importance of beneficial Insects, Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Role of pollinators in cross pollinated plants. Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing, mounting and harvesting of cocoons. Pest and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection. Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac- products. Identification of major parasitoids and predators commonly being used in biological control. Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance.

Practical

Honey bee species, castes of bees. Beekeeping appliances and seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Species of lac insect, host plant identification. Identification of other important pollinators, weed killers and scavengers. Visit to research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies. Identification and techniques for mass multiplication of natural enemies.

A. THEORY

Learning objectives:

- To understand the importance of beneficial insects, beekeeping and pollinators.*
- To identify diseases of beneficial insect and their management.*
- To impart knowledge on the silkworm, voltinism and biology of silkworm. Mulberry cultivation.*

Prerequisite: Software, computer, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module I: Importance of beneficial Insects, Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee.	3	19

Module-II: Role of pollinators in cross pollinated plants. Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing, mounting and harvesting of cocoons. Pest and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection.	5	31
Module-III: Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac-products. Identification of major parasitoids and predators commonly being used in biological control.	4	25
Module-IV: Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance.	4	25

• **Course learning outcome:**

CO1: To know about the importance of beneficial insects.

CO2: To attain a solid information on the basics of role of pollinators, silkworm and lac insects.

CO3: To know about the methods biological control.

CO4: To impart vast scientific knowledge on mass multiplication of natural enemies.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board.

PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

1. Ability to identify beneficial insects.
2. Expertise to carry out apiculture, silkworm rearing and lac culture unit in any agricultural farm.
3. Techniques to develop mass multiplication unit of several beneficial organisms.

Continuous assessment: Quiz/ assessment/ assignment/ problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To learn about the basics of importance of beneficial insects.
2. To acquire knowledge about the role of biological control.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Honey bee species.

Practical-2: Castes of bees.

Practical 3: Beekeeping appliances and seasonal management.

Practical 4: Bee enemies and disease.

Practical 5: Bee pasturage, bee foraging and communication.

Practical 6: Types of silkworm, voltinism and biology of silkworm.

Practical 7: Mulberry cultivation and mulberry varieties.

Practical 8: Methods of harvesting and preservation of leaves.

Practical 9: Species of lac insect and host plant identification.

Practical-10: Identification of other important pollinators.

Practical 11: Identification of weed killers.

Practical 12: Identification of scavengers.

Practical 13: Visit to research and training institutions devoted to beekeeping and sericulture.

Practical 14: Visit to research and training institutions devoted to lac culture.

Practical 15: Visit to research and training institutions devoted to natural enemies.

Practical 16: Identification and techniques for mass multiplication of natural enemies.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. DeBach P. 1991. *Biological Control by Natural Enemies*. Cambridge University Press..
2. Dhaliwal G S and Arora R. 2016. *Integrated Pest Management: Concepts and Approaches*. Kalyani Publishers.

Course title: Crop Improvement – II (Rabi)

Course Code: 1280015353

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		2(1+1)	16		16			3	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:**Theory:**

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fodder crops and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology of rabi crops. Ideotype concept and climate resilient crop varieties for future.

Practical:

Floral biology, emasculation and hybridization techniques in different crop species namely Wheat, Oat, Barley, Chickpea, Lentil, Field pea, Rajma, Horse gram, Rapeseed Mustard, Sunflower, Safflower, Potato, Berseem. Sugarcane, Tomato, Chilli, Onion; Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seeds production in *Rabi* crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, study of donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops

A. THEORY*Learning objectives:*

1. *This course is designed such a way that students will understand the origin, distribution and different breeding methods to be adopted for the development of varieties / hybrids in various rabi crops.*
2. *Students will know about plant genetic resources, centres of diversity in detail. In this course breeding for resistance to biotic and abiotic stresses and quality improvement is elaborately discussed.*
3. *Students will learn about learn about the ideotypes and climate resilient crop varieties for future.*

Prerequisite: Well-equipped laboratory, white board and marker, classroom with projector.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fodder crops and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation;	4	25
Module-II: Major breeding objectives and	5	31

procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional);		
Module-III: study of genetics of qualitative and quantitative characters; Hybrid seed production technology of rabi crops.	4	25
Module-IV: Ideotype concept and climate resilient crop varieties for future.	3	19

Course learning outcome:

CO1: Understand the origin, distribution and different breeding methods to be adopted for the development of varieties / hybrids in various field and horticultural crops grown in rabi season.

CO2: Know about the plant genetic resources, centres of diversity and breeding for resistance to biotic and abiotic stresses and improvement of quality (physical, chemical, nutritional parameters);

CO3: Learn about the influence of Genotype x Environment interaction on yield / performance and Hybrid seed production technology of rabi crops.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

1. Idea about emasculation and crossing techniques, field techniques for seed production and hybrid seed development in rabi crops
2. Maintenance of segregating generation
3. Developing an idea about selection procedure with and without molecular markers.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To enrich students about floral biology and emasculation techniques about different rabi crops.
2. To make them understand about field techniques for seed production and hybrid seeds production in Rabi crops

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Floral biology, emasculation and hybridization techniques in wheat

Practical-2: Floral biology, emasculation and hybridization techniques in oat, barley

Practical-3: Floral biology, emasculation and hybridization techniques in chick pea, lentil

Practical-4: Floral biology, emasculation and hybridization techniques in field pea, rajma

Practical-5: Floral biology, emasculation and hybridization techniques in horse gram, rapeseed mustard

Practical-6: Floral biology, emasculation and hybridization techniques in Sunflower, Safflower, Potato

Practical-7: Floral biology, emasculation and hybridization techniques in Berseem. Sugarcane

Practical-8: Floral biology, emasculation and hybridization techniques in Tomato, Chilli, Onion

Practical-9: Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods;

Practical-10: Study of field techniques for seed production and hybrid seeds production in Rabi crops- Part 1

Practical-11: Study of field techniques for seed production and hybrid seeds production in Rabi crops-Part 2

Practical-12: Estimation of heterosis, inbreeding depression and heritability

Practical-13: Layout of field experiments

Practical-14: Study of quality characters, study of donor parents for different characters

Practical-15: Visit to seed production plots;

Practical-16: Visit to AICRP plots of different field crops

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Crop Breeding and Biotechnology by Hari Har Ram, Kalyani Publication New Delhi.
2. Principle and Procedures of Plant Breeding Biotechnological and Conventional Approach by G. S. Chahal and S. S. Gosla, Narosa Publishers House. New Delhi.
3. Breeding of Asian Field crops by D. A. Sleper J.M. Poehlman, Blackwell Publishers

Course title: Practical Crop Production Technology-II (Rabi Crops)

Course Code: 1280015254

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2 (0+2)			32			2	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
32	2

Component:**Practical**

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

Learning objectives:

To teach the practical growing of crop husbandry of different rabi crop.

Prerequisite: Land, lab, classroom.

Course learning outcome: *This course offers a wide scope for students in skill development regarding rabi crop production, management and post-harvest handling.*

CO1: Students will be able to prepare field, nursery management, sowing, nutrient management, water and weed management.

CO2: Students will be able to manage disease and insect, harvest, store and sell the product.

CO3: Students will be able to prepare balance sheet.

Pedagogy for Course Delivery: *Power point presentation, Verbal presentation by Using white board and marker*

List of Professional Skill Development Activities (PSDA)

- 1. Demonstrate an ability to work effectively with others.*
- 2. Recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable decisions.*
- 3. A fundamental understanding of economic principles and their application to agricultural, resource, rural and related issues.*
- 4. Knowledge dissemination regarding various technique of farming and farming system, types of market and marketing of agricultural produce.*
- 5. Acquire the ability to engage in independent and life-long learning in the ever-changing agricultural production system/enterprises.*

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

To teach the practical growing of crop husbandry of different rabi crop.

Total no. of practical	Total contact hour	Contact hour/week
32	64	2

List of practical

- Practical-1: Crop planning and raising field crops in multiple cropping systems.
- Practical-2: Field layout preparation, seed treatment, nursery raising and sowing.
- Practical-3: Nutrient management.
- Practical-4: Water management.
- Practical-5: Weed management.
- Practical-6: Management of insect-pests diseases of crops.
- Practical-7: Harvesting.
- Practical-8: Threshing, drying , winnowing & storage.
- Practical-9: Marketing of produce.
- Practical-10: Seed production.
- Practical-11: Mechanization.
- Practical-12: Resource conservation management.
- Practical-13: Integrated nutrient management.
- Practical-14: Insect-pest management technologies.
- Practical-15: Disease management technologies.
- Practical-16: Preparation of Balance Sheet Including Cost of Cultivation, Net Returns Per Student as well as Per Team of a Group of Students.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. *Irrigation Water Management- Dilip Kumar Majumdar*
2. *Soil Fertility and Fertilizers- Tisdale and Nelson*
3. *Field Crop Production- Rajendra Prasad*

Course title: Principles of Organic Farming

Course Code: 1280015355

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2 (1+1)	16		16			1	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Organic farming, principles and its scope in India; Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture; Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP; Certification process and standards of organic farming; Processing, leveling, economic considerations and viability, marketing and export potential of organic products.

Practical

Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost, bio-fertilizers/bio-inoculants and their quality analysis; Indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management; Cost of organic production system; Post harvest management; Quality aspect, grading, packaging and handling.

A. THEORY

Learning objectives:

1. To understand the Concept of Organic Farming.
2. To understand the Scope and Importance of Organic Farming.
3. To ensure Safe and Healthy Food production.

Prerequisite: Classroom, field.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Organic farming, principles and its scope in India; Initiatives taken by Government (central/state). NGOs and other organizations for promotion of organic agriculture.	4	25
Module-II: Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming.	4	25
Module-III: Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of	4	25

NPOP.		
Module-IV: Certification process and standards of organic farming; Processing, leveling, economic considerations and viability, marketing and export potential of organic products.	4	25

Course learning outcome: On successful completion of this course students will be able to

CO1: Understand the Role of an Organic Grower.

CO2: Understand the Scope and Opportunities of Organic Farming.

CO3: Can develop an organic production system

Pedagogy for Course Delivery: PowerPoint presentation, white board, marker.

List of Professional Skill Development Activities (PSDA)

1. Skill regarding the organic crop production and certification.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To know various components organic farming and their utilization.
2. To prepare enrich compost, vermicompost, bio-fertilizers/bio-inoculants
3. To get idea on Indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management.
4. To get knowledge on Post harvest management of crops.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Study on various components organic farming and their utilization.

Practical-2: Visit of organic farms to study the various components and their utilization.

Practical-3: Preparation of enrich compost and their quality analysis.

Practical-4: Preparation of vermi-compost and their quality analysis.

Practical-5: Preparation of bio-fertilizers/bio-inoculants and their quality analysis.

Practical-6: Indigenous technology knowledge (ITK) for nutrient management.

Practical-7: Indigenous technology knowledge (ITK) for disease pest management.

Practical-8: Indigenous technology knowledge (ITK) for weed management.

Practical-9: Cost calculation of organic production system.

Practical-10: Post harvest management of organically produced food.

Practical-11: Exercise on quality aspect, grading, packaging and handling of organically produced food.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

Organic Farming by Sarath Chandran, Unni M.R., Sabu Thomas, eBook ISBN: 9780128132739

Course title: Farm Management, Production and Resource Economics

Course Code: 114001436

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		2 (1+1)	16		16			5	32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
48	3

Component:

Theory

Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factor determining types and size of farms. Principles of farm management: concept of production function and its type, use of production function in decision-making on a farm, factor-product, factor-factor and product-product relationship, law of equi-marginal/or principles of opportunity cost and law of comparative advantage. Meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock’s enterprises. Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies, Crop/livestock/machinery insurance– weather based crop insurance, features, determinants of compensation. Concepts of resource economics, differences between NRE and agricultural economics, unique properties of natural resources. Positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources etc.

Practical

Preparation of farm layout. Determination of cost of fencing of a farm. Computation of depreciation cost of farm assets. Application of equi-marginal returns/opportunity cost principle in allocation of farm resources. Determination of most profitable level of inputs use in a farm production process. Determination of least cost combination of inputs. Selection of most profitable enterprise combination. Application of cost principles including CACP concepts in the estimation of cost of crop and livestock enterprises. Preparation of farm plan and budget, farm records and accounts and profit & loss accounts. Collection and analysis of data on various resources in India.

A. THEORY

Learning objectives:

1. To impart knowledge on farm planning and budgeting-linear programming, appraisal of farm resources to the students of agricultural economics.
2. To train the students in production economics tools for agricultural decision making.
3. To make understanding in the students about the farm management, production and resource economics.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factor determining types and size of farms.	3	18
Module-II: Principles of farm management: concept of production function and its type, use of production function in decision-making on a farm, factor-product, factor-factor and product relationship, law of equi-marginal/or principles of opportunity cost and law of comparative advantage. Meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income.	7	45
Module-III: Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.	2	12
Module-IV: Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies, Crop/livestock/machinery insurance – weather based crop insurance, features, determinants of compensation. Concepts of resource economics, differences between NRE and agricultural economics, unique properties of natural resources. Positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources etc.	4	25

Course learning outcome:

CO1: To remember the concept farm management, objectives and relationship with other sciences.

CO2: To understand efficient allocation of natural resources and explore the concept of efficiency.

CO3: To apply use of production function in decision-making on a farm, factor-product, factor-factor and product-product relationship.

CO4: To discuss Farm business analysis: meaning and concept of farm income and profitability.

CO5: To evaluate farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises.

CO6: To create various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts

Pedagogy for Course Delivery: PowerPoint presentation and verbal presentation by using White board and marker.

List of Professional Skill Development Activities (PSDA)

1. Expose the students to production economics principles and their applications.
2. Students will be able to discuss Farm business analysis: meaning and concept of farm income and profitability.
3. Gain knowledge on efficient allocation of natural resources and explore the concept of efficiency.
4. Impart knowledge of Linear programming techniques and its applications in agricultural production decisions.
5. Students will know about concept farm management, objectives and relationship with other sciences.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To discuss Farm business analysis: meaning and concept of farm income and profitability.
2. To prepare farm lay-out with the selection of most profitable enterprise combination and most profitable level of input use and output level in a farm production process.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Preparation of farm lay-out

Practical-2: Determination of cost of fencing of a farm

Practical-3: Computation of depreciation cost of farm assets

Practical-4: Determination of most profitable level of input use and output level in a farm production process.

Practical-5: Determination of least cost combination of inputs

Practical-6: Application of equi-marginal returns/opportunity cost principle in allocation of farm resources

Practical-7: Selection of most profitable enterprise combination

Practical-8: Estimation of cost and profitability based on CACP cost concept and break even analysis.

Practical-9: Preparation of farm plan and budget

Practical-10: Preparation of farm records

Practical-11: Preparation and analysis of Balance-sheet and Income- statement.

Practical-12: Preparation of a journal in a particular farm.

Practical-13: Preparation of a farm inventory of a hypothetical farm.

Practical-14: Collection and analysis of data on various resources in India (Part-I)

Practical-15: Collection and analysis of data on various resources in India (Part-II)

Practical-16: Visit of institutional farm for understanding about various farm records

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. *Principles and Methods of Farm Management* by R. K. Tandan & S.P. Dhondiyal, Kalyani Publisher.
2. *Fundamental of Farm Business Management* by S.S. Johl and T.P. Kapoor, Kalyani Publisher.
3. *S. Subba Reddy, P. Raghu Ram, T. V. Neelakanta Sastry and I. Bhavani Devi. Agricultural Economics.*
4. *Economics of Farm Production and Management* by V.T Raju and D. V. S. Rao.

Course title: Principles of Food Science & Nutrition

Course Code: 1280015157

Type	Code	Credit	Credit division					Total no of lecture
			L	T	P	SW	FW	
Compulsory		2 (2+0)	2		0			32

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
32	2

Component:

Theory

Concepts of Food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.); Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions); Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods); Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc.); Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders; Energy metabolism (carbohydrate, fat, proteins); Balanced/ modified diets, Menu planning, New trends in food science and nutrition.

A.THEORY

Learning objectives:

Main objective of this subject is to improve knowledge about the principles of food science and nutrition

Prerequisite: Classroom, well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Concepts of Food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.).	2	6
Module-II: Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions)	11	33
Module-III: Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods); Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc.);	10	31
Module-IV: Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders; Energy metabolism (carbohydrate, fat, proteins); Balanced/ modified diets, Menu planning, New trends in food science and nutrition.	09	30

Course learning outcome:

CO1: Students will gather knowledge about the Food science and new technology developed related to the global food security.

CO2: Students will impart knowledge about the food science, food composition and chemistry water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactive, important reactions.

CO3: Student can analyze and identify the use of food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods

CO4: Students will be able to understand food and nutrition, malnutrition (over and under nutrition), nutritional disorders

Pedagogy for Course Delivery:

List of Professional Skill Development Activities (PSDA)

Major part of the course shall be delivered using Markers on White board.

PPT's may be used for showing various types of disease symptoms as well as for review of prerequisite topics/revision of current topics.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

Text & Reference books:

- *Food Science and Nutrition (second edition) by Sunetra Roday*
- *Food facts and Principles by N. Shakuntala Manay*

Elective Courses

Semester-4th / 5th / 6th

Course title: Landscaping

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Compulsory		3 (2+1)	32		16			2	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

Importance and scope of landscaping. Principles of landscaping, garden styles and types, terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery, water garden, walk-paths, bridges, other constructed features etc. gardens for special purposes. Trees: selection, propagation, planting schemes, canopy management, shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers: importance, selection, propagation, planting, Annuals: selection, propagation,

planting scheme, Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management. Bio-aesthetic planning: definition, need, planning; landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions. Bonsai: principles and management, lawn: establishment and maintenance. CAD application.

Practical

Identification of trees, shrubs, annuals, pot plants; Propagation of trees, shrubs and annuals, care and maintenance of plants, potting and repotting, identification of tools and implements used in landscape design, training and pruning of plants for special effects, lawn establishment and maintenance, layout of formal gardens, informal gardens, special type of gardens (sunken garden, terrace garden, rock garden) and designing of conservatory and lathe house. Use of computer software, visit to important gardens/ parks/ institutes.

A. THEORY

Learning objectives:

- To enhance the aesthetic appeal of an area.
- To increase the property value.
- To secure attractive ground.

Prerequisite: Lab, Classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Importance and scope of landscaping. Principles of landscaping, garden styles and types, terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery, water garden, walk-paths, bridges, other constructed features etc. gardens for special purposes.	10	31
Module-II: Trees: selection, propagation, planting schemes, canopy management, shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers: importance, selection, propagation, planting, Annuals: selection, propagation, planting scheme,	8	32
Module-III: Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management. Bio-aesthetic planning: definition, need, planning; landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions.	10	31
Module-IV: Bonsai: principles and management, lawn: establishment and maintenance. CAD application.	4	

Course learning outcome:

CO1: Students will be able to differentiate the mechanisms involved in plant physiology and growth.

CO2: Students will be able to categorize plants based on growth, morphological, and taxonomic characteristics.

CO3: Students will be able to design a landscape or interior scape project.

							PSDA	
Compulsory		3 (2+1)	2		1		2	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

UNIT I- An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture.

UNIT II- Herbicides-Major classes, properties and important herbicides. Fate of herbicides. Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use of sulfur and copper, Mode of action-Bordeaux mixture and copper oxychloride. Organic fungicides- Mode of action- Dithiocarbamates-characteristics, preparation and use of Zineb and maneb. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification of insecticides: inorganic and organic insecticides Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids Neonicotinoids, Biorationals, Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, Fate of insecticides in soil & plant. IGRs Biopesticides, Reduced risk insecticides, Botanicals, plant and animal systemic insecticides their characteristics and uses. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

UNIT III- Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate. Mixed and complex fertilizers: Sources and compatibility–preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistics and marketing.

Practical

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available in market. Estimation of nitrogen in Urea. Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate. Estimation of potassium in Muriate of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content.

A. THEORY

Learning objectives:

- To gain theoretical knowledge on agrochemicals- their type and role in agriculture, effect on environment, soil, human and animal health; management of agrochemicals for sustainable agriculture.*
- To impart knowledge about the major classes, properties of important herbicides; fate of herbicides; classification, fates of fungicides and classification of insecticides; manufacturing processes and properties of N, P and K fertilizers, complex fertilizers, secondary and micronutrient fertilizers; fertilizer control order; fertilizer logistics*

and marketing; plant bio-pesticides for ecological agriculture; bio-insect repellent etc.

Prerequisite: Software, computer, classroom.

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture.	6	19
Module-II: Herbicides-Major classes, properties and important herbicides. Fate of herbicides. Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use of sulfur and copper, Mode of action-Bordeaux mixture and copper oxychloride. Organic fungicides- Mode of action- Dithiocarbamates-characteristics, preparation and use of Zineb and maneb. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification of insecticides: inorganic and organic insecticides Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids Neonicotinoids, Biorationals, Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, Fate of insecticides in soil & plant. IGRs Biopesticides, Reduced risk insecticides, Botanicals, plant and animal systemic insecticides their characteristics and uses. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.	14	44
Module-III: Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate. Mixed and complex fertilizers: Sources and compatibility–preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistics and marketing.	12	37

• **Course learning outcome:**

CO1: To understand the importance of agrochemicals in agricultural production.

CO2: To explain the types of pesticides, their mode of action, manufacturing, their applications and laws enforcing their industrial manufacturing processes in India.

CO3: To explain the types of fertilizers, their mode of action, manufacturing, their applications and laws enforcing their industrial manufacturing processes in India.

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board.

PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

1. Techniques of fertilizer and pesticide handling.
2. Fertilizer and pesticide recommendation for crop management practices.

Continuous assessment: Quiz/ assessment/ assignment/ problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To understand the working principles of different instruments used in the pesticide and fertilizer analytical laboratories
2. To explain the sampling and analytical process of nutrient in fertilizers and pesticides.
3. Interpret the nutrient data for precise fertilizer and pesticide recommendation.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical 1: Sampling of fertilizers.

Practical 2: Sampling of pesticides.

Practical 3: Pesticides application technology to study about various pesticides appliances.

Practical 4: Quick tests for identification of common fertilizers.

Practical 5: Identification of anion and cation in fertilizer.

Practical 6: Calculation of doses of insecticides to be used.

Practical 7: To study and identify various formulations of insecticide available in market.

Practical 8: Estimation of nitrogen in Urea.

Practical 9: Estimation of water soluble P_2O_5 in single super phosphate.

Practical 10: Estimation of citrate soluble P_2O_5 in single super phosphate.

Practical 11: Estimation of potassium in Muriate of Potash by flame photometer.

Practical 12: Estimation of potassium in Sulphate of Potash by flame photometer.

Practical 13: Determination of copper content in copper oxychloride.

Practical 14: Determination of sulphur content in sulphur fungicide.

Practical 15: Determination of thiram content.

Practical 16: Determination of ziram content.

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. Rakshit A., Raha P., Dey N. (2015) Manures, Fertilizers and Pesticides: Theory and Application. CBS Publishers & Distributors, New Delhi.

2. Roy NK (2017). *Chemistry of Pesticides*. CBS Publishers & Distributors, New Delhi.
3. Indian Society of Soil Science. (2012). *Fundamentals of Soil Science*, IARI, New Delhi.
4. Das, D.K. (2015). *Introductory Soil Science, 4th Edition*, Kalyani Publishers, New Delhi.

Course title: Biopesticides & Biofertilizers

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Compulsory		3 (2+1)	2		1			1	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory

Biopesticides: History and concept of biopesticides. Importance, scope and potential of biopesticide. Definitions, concepts and classification of biopesticides viz. pathogen, botanical pesticides, and biorationales. Botanicals and their uses. Mass production technology of bio-pesticides. Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes. Methods of application of biopesticides. Methods of quality control and Techniques of biopesticides. Impediments and limitation in production and use of biopesticide.

Biofertilizers: Introduction, status and scope. Structure and characteristic features of bacterial biofertilizers- *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* and *Frankia*; Cynobacterial biofertilizers- *Anabaena*, *Nostoc*, *Hapalosiphon* and fungal biofertilizers- AM mycorrhiza and ectomycorrhiza. Nitrogen fixation -Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilization and phosphate mobilization, K solubilization. Production technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers. FCO specifications and quality control of biofertilizers. Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers -Storage, shelf life, quality control and marketing. Factors influencing the efficacy of biofertilizers.

Practical

Isolation and purification of important biopesticides: *Trichoderma*, *Pseudomonas*, *Bacillus*, *Metarhizium* etc. and its production. Identification of important botanicals. Visit to biopesticide laboratory in nearby area. Field visit to explore naturally infected cadavers. Identification of entomopathogenic entities in field condition. Quality control of biopesticides. Isolation and purification of *Azospirillum*, *Azotobacter*, *Rhizobium*, P-solubilizers and cyanobacteria. Mass multiplication and inoculums production of biofertilizers. Isolation of AM fungi -Wet sieving method and sucrose gradient method. Mass production of AM inoculants.

A.THEORY

Learning objectives:

Main objectives of this subject is to familiarize the students about the biopesticides and biofertilizers which are free from harmful chemicals and more environment friendly and future of the crop production.

Prerequisite: Classroom, well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: History and concept of biopesticides. Importance, scope and potential of biopesticide. Definitions, concepts and classification of biopesticides viz. pathogen, botanical pesticides, and bio rationales. Botanicals and their uses.	7	21
Module-II: Mass production technology of bio-	5	16

pesticides. Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes. Methods of application of biopesticides. Methods of quality control and Techniques of biopesticides. Impediments and limitation in production and use of biopesticides.		
Module-III: Introduction, status and scope. Structure and characteristic features of bacterial biofertilizers- <i>Azospirillum</i> , <i>Azotobacter</i> , <i>Bacillus</i> , <i>Pseudomonas</i> , <i>Rhizobium</i> and <i>Frankia</i> ; Cynobacterial biofertilizers- <i>Anabaena</i> , <i>Nostoc</i> , Hapalosiphon and fungal biofertilizers- AM mycorrhiza and ectomycorrhiza. Nitrogen fixation -Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilization and phosphate mobilization, K solubilisation.	13	42
Module-IV: Production technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertiizers. FCO specifications and quality control of biofertilizers. Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers -Storage, shelf life, quality control and marketing. Factors influencing the efficacy of biofertilizers.	7	21

Course learning outcome:

CO1: To gather knowledge about importance, scope and potential of biopesticides

CO2: To impart knowledge about bio fertilizers, its status and scope. Characteristic features of various bacterial bio fertilizers.

CO3: To understand about the production technology: Strain selection, sterilization, growth and fermentation, mass production of carrier

CO4: To analyze the effectivity of biopesticides & biofertilizer in modern agriculture, its advantage and disadvantage in agriculture.

Pedagogy for Course Delivery:

List of Professional Skill Development Activities (PSDA)

- Visit to the Central Integrated Pest Management Centre, Govt. of India to train the students about production of biopesticides, how to maintain biocontrol agents and also their use in agriculture.

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL(total contact hours, hr/week), if applicable

Learning objectives:

Main objectives of this subject is to familiarize the students about the biopesticides and biofertilizers which are free from harmful chemicals and more environment friendly and future of the crop production.

Total no. of practical	Total contact hour	Contact hour/week
16	32	2

List of practical

Practical-1: Isolation and purification of important biopesticides: *Trichoderma*

Practical-2: Isolation and purification of important biopesticides: *Pseudomonas*
Practical-3: Isolation and purification of important biopesticides: *Bacillus*
Practical-4: Isolation and purification of important biopesticides: *Metarhizium*
Practical-5: Isolation and purification of important biopesticides: NPV
Practical-6: Identification of important botanicals.
Practical-7: Visit to biopesticides laboratory in nearby area.
Practical-8: Identification of entomopathogenic entities in field condition.
Practical-9: Quality control of biopesticides.
Practical-10: Isolation and purification of *Azospirillum*, *Azotobacter*, *Rhizobium*, P-solubilizers and cyanobacteria.
Practical-11: Mass multiplication and inoculums production of bio fertilizers.
Practical-12: Isolation of AM fungi -Wet sieving method and sucrose gradient method.
Practical-13: Mass production of AM inoculants

Continuous assessment: Quiz/assessment/identification/Harberium etc.

Text & Reference books:

- *Biofertilizers and Biopesticides* by Channabasava A and Lakshman, H. C.
- *Biofertilizers and Biopesticides* by Shalini Suri

Course title: Micro propagation Technologies

Type	Code	Credit	Credit division					Total no of lecture
			L	T	P	SW	FW	
Compulsory		3 (1+2)	16		32			48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
80	5

Component:**Theory**

Introduction, History, Advantages and limitations; Types of cultures (seed, embryo, organ, callus, cell), Stages of micropropagation, Axillary bud proliferation (Shoot tip and meristem culture, bud culture), Organogenesis (callus and direct organ formation), Somatic embryogenesis, cell suspension cultures, Production of secondary metabolites, Somaclonal variation, Cryopreservation.

Practical

Identification and use of equipments in tissue culture Laboratory, Nutrition media composition, sterilization techniques for media, containers and small instruments, sterilization techniques for explants, Preparation of stocks and working solution, Preparation of working medium, Culturing of explants: Seeds, shoot tip and single node, Callus induction, Induction of somatic embryos regeneration of whole plants from different explants, Hardening procedures.

A. THEORY

Learning objectives:

- 1. To understand different stage in vitro propagation*
- 2. To learn about different type of culture*
- 3. To learn about organogenesis and somatic embryogenesis*
- 4. To teach the students about in vitro conservation*

Prerequisite: Classroom, well equipped laboratory

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Introduction, History, Advantages and limitations	2	12
Module-II: Types of cultures (seed, embryo, organ, callus, cell), Stages of micropropagation, Axillary bud proliferation (Shoot tip and meristem culture, bud culture)	5	32
Module-III: Organogenesis (callus and direct organ formation), Somatic embryogenesis, cell suspension cultures	5	32
Module-IV:	4	24

Production of secondary metabolites, Somaclonal variation, Cryopreservation		
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Course learning outcome:

CO1: Demonstrate *in vitro* culture.

CO2: Understand preparation of culture media & reagents

CO3: Interpret basics of tissue culture, organ micro-culture and plant micro-propagation.

CO4: Production of secondary metabolites

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics. Online Course Material that available at NPTEL/MOOC/SWAYAM and other educational sites may be consulted for enhanced learning.

List of Professional Skill Development Activities (PSDA)

4. Entrepreneurship
5. Work shop

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To learn the handling of different instrument
2. To learn preparing different nutrition media
3. To learn about *in vitro* culture of different explants

Total no. of practical	Total contact hour	Contact hour/week
32	64	4

List of practical

Practical-1: Identification and use of equipments in tissue culture Laboratory

Practical-2: Plant tissue culture laboratory layout

Practical-3: Preparation of nutrition media

Practical-4: Sterilization techniques for media, containers and small instruments- I

Practical-5: Sterilization techniques for media, containers and small instruments- II

Practical-6: Sterilization techniques for explants

Practical-7: Preparation of stocks solution for MS media

Practical-8: Preparation of working solution for MS media

Practical-9: Preparation of MS medium for Shoot culture

Practical-10: Micropropagation of shoot tip- I

Practical-11: Micropropagation of shoot tip- II

Practical-12: *In vitro* seed culture

Practical-13: *In vitro* induction of callus

Practical-14: Micropropagation of nodal explant- I

Practical-15: Micropropagation of nodal explant- II

Practical-16: Induction of somatic embryos regeneration of whole plants from different explants- I

Practical-17: Induction of somatic embryos regeneration of whole plants from different explants- II

Practical-18: Induction of somatic embryos regeneration of whole plants from different explants- III

Practical-19: Primary Hardening

Practical-20: Secondary Hardening

Continuous assessment: Quiz/assessment/identification/problem solving etc.

Text & Reference books:

S.No.	Name	Author(S)	Publisher
1	Plant Tissue Culture	S Kumar	Scientific Publishers Journals Dept
2	Introduction to plant tissue culture	M K Razdan	Science Pub Inc

Course title: Agri-Business Management

Type	Code	Credit	Credit division						Total no of lecture
			L	T	P	SW	FW	No. of PSDA	
Elective		3 (2+1)	32	0	16	0	3	5	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:**Theory**

Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy. Distinctive features of Agribusiness Management: Importance and needs of agro-based industries, Classification of industries and types of agro based industries. Institutional arrangement, procedures to set up agro based industries. Constraints in establishing agro-based industries. Agri value chain: Understanding and support primary activities and their linkages. Business environment: PEST & SWOT analysis. Management functions: Roles & activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, policies procedures, rules, programs and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications, control. Capital Management and Financial management of Agribusiness. Financial statements and their importance. Marketing Management: Segmentation, targeting & positioning. Marketing mix and marketing strategies. Consumer behaviour analysis, Product Life Cycle (PLC). Sales & Distribution Management. Pricing policy, various pricing methods. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.

Practical

Study of agri-input markets: Seed, fertilizers, pesticides. Study of output markets: grains, fruits, vegetables, flowers. Study of product markets, retails trade commodity trading, and value added products. Study of financing institutions- Cooperative, Commercial banks, RRBs, Agribusiness Finance Limited, NABARD. Preparations of projects and Feasibility reports for agribusiness entrepreneur. Appraisal/evaluation techniques of identifying viable project- Non-discounting techniques. Case study of agro-based industries. Trend and growth rate of prices of agricultural commodities. Net present worth technique for selection of viable project. Internal rate of return.

A. THEORY*Learning objectives:*

- To familiarize the student about the Agri-Business Management which enables him to set commercial agribusiness of big farms*
- To learn types of agro-based industries, different marketing systems, different pricing systems and procedure for setting up an agro based industry.*

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy.	8	25

Module-II: Distinctive features of Agribusiness Management: Importance and needs of agro-based industries, Classification of industries and types of agro based industries. Institutional arrangement, procedures to set up agro based industries. Constraints in establishing agro-based industries. Agri value chain: Understanding and support primary activities and their linkages.	9	28
Module-III: Business environment: PEST & SWOT analysis. Management functions: Roles & activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, policies procedures, rules, programs and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications, control.	7	22
Module-IV: Capital Management and Financial management of Agribusiness. Financial statements and their importance. Marketing Management: Segmentation, targeting & positioning. Marketing mix and marketing strategies. Consumer behaviour analysis, Product Life Cycle (PLC). Sales & Distribution Management. Pricing policy, various pricing methods. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.	8	25

Course learning outcome: Students will get knowledge about Importance of agribusiness management in the Indian economy, management structure and definitions, capital management and financial management.

CO1: To apply knowledge about Importance of agribusiness management in the Indian economy, Management structure and definitions, capital management and financial management.

CO2: To create different marketing systems, different pricing systems and procedure for setting up an agro based industry.

CO3: To evaluate methods of making of balance sheets, profit and loss statements.

CO4: To analyse product knowledge to improve customer relations to set up an agro based industry.

Pedagogy for Course Delivery: PowerPoint presentation and verbal presentation by using White board and marker.

List of Professional Skill Development Activities (PSDA)

1. Product knowledge to improve customer relations to set up an agro based industry.
2. Gain knowledge on ability to solve problems for setting up an agro based industry.

3. *Impart knowledge of planning and implementation, organization staffing, directing, motivation, ordering, leading, supervision, communications and control.*
4. *Gain knowledge on capital management and financial management of Agribusiness*
5. *Students will know method of making of balance sheets, profit and loss statements.*

Continuous assessment: Quiz, assessment, assignment, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. *To discuss input market, output, product markets, retails trade commodity trading, and value added products.*
2. *To learn Trend and growth rate of prices of agricultural commodities.*

<i>Total no. of practical</i>	<i>Total contact hour</i>	<i>Contact hour/week</i>
16	32	2

List of practical

- Practical-1: Study of Input Market: Seed, Fertilizer, Pesticides
 Practical-2: Study of output market: Grain, fruits, Vegetables, Flower
 Practical-3: Study of Product Market: Retail trade, Commodity Trading, Value added products.
 Practical-4: Study of Financing Institution: co-operatives, Commercial Banks.
 Practical-5: Study of Regional Rural Bank
 Practical-6: Study of Agribusiness Finance Ltd.
 Practical-7: Study of NABARD
 Practical-8: Study of Financial Criteria for appraisal of the project
 Practical-9: Appraisal of irrigation project
 Practical-10: Study of Financial Test ratios for evaluation of Agro based Industries
 Practical-11: Study of Methods of Project evaluation
 Practical-12: Case study of Agro based Industries
 Practical-13: Visit to financial institution
 Practical-14: Study on E- Commerce of Agricultural commodities
 Practical-15: Visit to Export market of grains, fruit, and flower, vegetable.
 Practical-16: Visit to processing industry, Malls and producers companies

Continuous assessment: Quiz/assessment/presentation/problem solving etc.

Text & Reference books:

1. *Agribusiness Management by Freddie L. Barnard, Jay T. Akridge and Frank J. Dooley, Routledge Publisher.*
2. *Principles of agribusiness management by James G Beierlein, Waveland Press Publisher.*

Course title: Commercial Plant Breeding

Type	Code	Credit	Credit division					Total no of lecture	
			L	T	P	SW	FW		No. of PSDA
Elective		3(1+2)	16		32			2	48

SW = Self work, FW = Field work, Professional Skill Development Activities (PSDA)

Total contact hour	Contact hour/week
64	4

Component:

Theory:

Types of crops and modes of plant reproduction. Line development and maintenance breeding in self- and cross-pollinated crops (A/B/R and two-line system) for development of hybrids and seed production. Genetic purity test of commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc. Quality seed production of vegetable crops under open and protected environment. Alternative strategies for the development of the line and cultivars: haploid inducer, tissue culture techniques and biotechnological tools. IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act. Variety testing, release and notification systems in India. Principles and techniques of seed production, types of seeds, quality testing in self- and cross-pollinated crops.

Practical:

Floral biology in self- and cross-pollinated species, selfing and crossing techniques. Techniques of seed production in self- and cross-pollinated crops using A/B/R and two-line system. Learning techniques in hybrid seed production using male-sterility in field crops. Understanding the difficulties in hybrid seed production, Tools and techniques for optimizing hybrid seed production. Concept of rouging in seed production plot. Concept of line its multiplication and purification in hybrid seed production. Role of pollinators in hybrid seed production. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops. Sampling and analytical procedures for purity testing and detection of spurious seed. Seed drying and storage structure in quality seed management. Screening techniques during seed processing viz., grading and packaging. Visit to public private seed production and processing plants.

A. THEORY

Learning objectives:

- To impart knowledge to the students on the principles and procedures of plant breeding in self- and cross-pollinated crops to develop the high yielding varieties / hybrids.*
 - To spread awareness regarding IPR, quality seed production etc.*
- Prerequisite: Well-equipped laboratory, white board and marker, classroom with projector.*

Course content/Syllabus:

Module no.	No of lecture/Contact hour	Weightage (%)
Module-I: Types of crops and modes of plant reproduction. Line development and maintenance breeding in self and cross pollinated crops (A/B/R and two line system) for development of hybrids and seed production. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc.	6	38
Module-II: Quality seed production of vegetable crops under open and protected environment. Alternative strategies for the development of the line and cultivars: haploid inducer, tissue culture techniques and biotechnological tools.	5	31

Module-III: Genetic purity test of commercial hybrids. IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act. Variety testing, release and notification systems in India. Principles and techniques of seed production, types of seeds, quality testing in self- and cross-pollinated crops.	5	31
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Course learning outcome:

CO1: Understand different mechanisms used by cultivated crop plants for reproduction, development of A, B and R line and their use in hybrid development

CO2: Learn breeding procedures in self- and cross-pollinated crops and understand exploitation of heterosis utilizing male sterility and other methods

CO3: Understand biotechnological and tissue culture tools used in development of cultivars

CO4: Know IPR issues in commercial plant breeding including different testing and release of varieties

CO5: Acquire knowledge on principles and techniques of seed production and seed quality test

Pedagogy for Course Delivery: Major part of the course shall be delivered using Markers on White board. PPT's may be used for Graphical representations (whenever required) as well as for review of prerequisite topics/revision of current topics.

List of Professional Skill Development Activities (PSDA):

1. Use of MS system during hybrid seed production
2. Acquaintance with different molecular techniques

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

B. PRACTICAL (total contact hours, hr/week), if applicable

Learning objectives:

1. To impart knowledge to the students on the principles and procedures of plant breeding in self- and cross-pollinated crops to develop the high yielding varieties / hybrids.
2. Helps to deal with heredity and the reasons behind the variation among individuals of the same species.

Total no. of practical	Total contact hour	Contact hour/week
32	64	4

List of practical

Practical-1: Floral biology in self pollinated species, selfing and crossing techniques (Part 1).

Practical-2: Floral biology in self pollinated species, selfing and crossing techniques. (Part 2)

Practical-3: Floral biology in cross pollinated species, selfing and crossing techniques (Part 1).

Practical-4: Floral biology in cross pollinated species, selfing and crossing techniques (Part 2)

Practical-5: Techniques of seed production in self pollinated crops using A/B/R and two line system.

Practical-6: Techniques of seed production in cross pollinated crops using A/B/R and two line system.

Practical-7: Learning techniques in hybrid seed production using male-sterility in field crops (Part 1)

Practical-8: Learning techniques in hybrid seed production using male-sterility in field crops (Part 2)

Practical-9: Understanding the difficulties in hybrid seed production

Practical-10: Tools and techniques for optimizing hybrid seed production.
Practical-11: Concept of rouging in seed production plot.
Practical-12: Concept of line, its multiplication and purification in hybrid seed production.
Practical-13: Role of pollinators in hybrid seed production
Practical-14: Hybrid seed production techniques in sorghum
Practical-15: Hybrid seed production techniques in pearl millet
Practical-16: Hybrid seed production techniques in maize
Practical-17: Hybrid seed production techniques in rice
Practical-18: Hybrid seed production techniques in rapeseed-mustard
Practical-19: Hybrid seed production techniques in sunflower
Practical-20: Hybrid seed production techniques in castor
Practical-21: Hybrid seed production techniques in pigeon pea
Practical-22: Hybrid seed production techniques in cotton
Practical-23: Hybrid seed production techniques in vegetable crops (Part 1)
Practical-24: Hybrid seed production techniques in vegetable crops (Part 2)
Practical-25: Hybrid seed production techniques in vegetable crops (Part 3)
Practical-26: Sampling procedures for purity testing and detection of spurious seed.
Practical-27: Analytical procedures for purity testing and detection of spurious seed.
Practical-28: Seed drying in quality seed management
Practical-29: Seed storage structure in quality seed management
Practical-30: Screening techniques during seed processing viz., grading and packaging
Practical-31: Visit to public private seed production plants.
Practical-32: Visit to public private seed processing plants.

Continuous assessment: Quiz, assessment, presentation, problem solving etc.

Text & Reference books:

1. Plant Breeding Principles and Methods by B.D. Singh, Kalyani Publishers.
2. Essentials of Plant Breeding by Phundan Singh, Kalyani Publishers.
3. Principles of Plant Breeding By Robert W Allard, Wiley; 2nd edition